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Creative Computing

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→ Education  
progs  
for  
Apprentice (etc.)

ny 8d

what is

# CONDUIT?





## why conduit?

Computing is a powerful technology that affects all aspects of everyday life. Because computing deals with processing information, and because it is interactive, it has the potential to enrich education. Today, instructional computing falls far beneath its potential, leaving a powerful resource almost untapped. The reasons for the lag in computer use in instruction compared to other uses are complex and numerous. Recent studies have pointed out that with the dramatic fall in the price of equipment, the single most important barrier to instructional computing is the lack of high quality curriculum materials. CONDUIT is attacking that barrier.





## a reliable source of instructional materials

CONDUIT is working to fill the need for a reliable source of high quality instructional materials. Our effort is outlined below:

### the problem

Instructors who wish to use the computer for teaching find it difficult to locate, purchase and use materials developed by others. One expert has noted that "(computer) materials are locally produced for local use, . . . most distribution is voluntary and episodic, it relies on the energy and enthusiasm of both author and user."

### the approach

CONDUIT has attacked this problem by becoming a source of computer-based instructional materials that are reviewed, well documented, programmed for ease of transfer, and kept up to date.

### content of materials

A typical reviewed and tested package consists of a computer program written in BASIC or FORTRAN, a student manual telling of objectives and methods of use, an instructor's guide illustrating course use, and notes describing installation of the materials on the computer. CONDUIT is also beginning to distribute microcomputer-based packages.

### types of materials

Our materials are designed to use computing to enrich instruction in a variety of ways. Several are computer simulations of situations that are impossible or too expensive to reproduce in a laboratory. Others help teach quantitative techniques for use in linear

algebra, calculus, operations management, ecological modeling, quantum mechanics, and comparative politics. Some provide problem-solving tools and some give data for student research. Recently we have begun distributing packages which provide drill and practice in essential skills or act as a tutor for students learning key course concepts.

### examples of materials

—SIMULATION The technique of genetic mapping requires the breeding of large numbers of organisms. Facilities for these breeding experiments are often difficult to provide in the undergraduate biology laboratory. The program *Linkover* overcomes this difficulty through computer simulation.

Using *Linkover*, students select parental genotypes and carry out simulated test crosses. The program produces a table of offspring phenotypes. Students can then use the genetic cross-over model to deduce the genetic map for the chromosome under study.

—PROBLEM SOLVING The CONDUIT package *Titration* consists of 11 programs covering topics within the general area of titration phenomena and ionic equilibria. For example, the program HNA solves a set of aqueous equilibria problems involving weak acids. Other programs in the package apply numerical methods to the solution of other problems in analytical chemistry, and in some cases, provide simulated laboratory data for student practice.

—DATA ANALYSIS The National Opinion Research Center (NORC) is a social research organization affiliated with the University of Chicago. The NORC *Cumulative General Social Survey* package offered by CONDUIT provides a rich source of data for use in many instructional settings. The data come from interviews administered to national samples yearly from 1972 through 1978. Questions cover areas including family information, socioeconomic status, and opinions on a variety of social issues, such as integration, the Equal Rights

Amendment, and legalized abortion. In the classroom, students can use the data to test hypotheses derived from readings and lectures. Methods classes can use the data for practice in analysis.

—DRILL AND PRACTICE      One of the most difficult skills for students to acquire in an introductory logic course is the ability to construct natural deductions—a skill which requires a great deal of practice. The *Bertie* package from CONDUIT provides an excellent vehicle for that practice.

As students construct a proof in one of *Bertie's* 50 exercises, each line of the proof is checked for well-formed formulas and correct justification. The immediate feedback prevents the perpetuation of incorrect "knowledge," reinforces correct use of logic, and quickens the learning process. Students may request assistance as they construct their proof, and may also enter problems of their own for *Bertie* to check. *Bertie* provides an essentially unlimited practice opportunity.

### disciplines

Materials are currently available for use in biology, chemistry, economics, education, geography, humanities, management science, mathematics, physics, sociology, political science, psychology, and statistics.

### review

All of our instructional materials are *peer reviewed* for conceptual validity, instructional usefulness, and overall quality. They are also *technically reviewed* for program accuracy and transferability to a wide range of computer systems.

### transferability

All materials include complete instructions on the use of the materials for teaching, notes about installation of the programs, and the programs themselves in a form that can be read by your computer. Programs are written in BASIC or FORTRAN, languages that will run on most existing systems, and checked for non-standard features that may cause you trouble. Our materials programmed in BASIC will run on most minicomputer systems and some microcomputer systems. We are currently translating some of our materials to run on the more popular microcomputers, taking advantage of their graphic display capabilities where appropriate. If you have questions about use on your systems, call us.

### quality

CONDUIT has gained an international reputation for its distribution of materials and has been referred to as the best source of instructional computer materials. If you order our materials and find them unsuitable, you may return them. Our return rate is less than two percent.

### maintenance

We provide telephone assistance to help you install and test our materials. If we update or correct a program, you will be notified of the correction.

### for whom

Anyone can order CONDUIT reviewed and tested materials. Materials have been sent to high schools, community colleges, four-year colleges, universities, institutes, departments, businesses, and individuals in all 50 states and 11 foreign countries.



CONDUIT is continually studying ways to make instructional computing more effective and more widely usable. Our staff is devoted to improving education. Long experience in solving transfer problems and evaluating instructional materials are our specific strengths. We are interested in design, development, style, packaging, evaluation, and use of computer-based instruction. Our present activities include research and development of authoring aids, programming standards, transfer guidelines, and evaluation tools. We are also conducting an on-going review of the state of the art of instructional computing.



### authoring aids

We are currently researching methods of designing and developing materials and establishing guidelines for student-computer dialogs. We have recently published the *CONDUIT Author's Guide* and developed prototype routines for answer processing and student-computer interaction. Many of these routines are available in our package *The User Frontend* (order #MUL220).

### programming standards

The use of simple standards for programming can enhance transfer of materials without significantly increasing development costs.

We are continually evaluating the use of standards and developing new ones to meet a changing computing scene. Our standards are now contained in the *Technical Transfer Guide*, the *Author's Guide* and the *CONDUIT BASIC Guide*. We currently have transfer standards for magnetic tape, paper tape, and punched cards, and are developing standards for flexible disk as transfer media.

### transfer guidelines

Many instructionally effective computer-based packages have been developed that cannot be easily moved from one school to another. We are working on solving transfer problems created by large instructional systems that use authoring languages, by smaller but powerful microcomputer-based systems and by use of graphic displays. Specifically, we are converting materials written in authoring languages into general purpose language programs, and are putting some of our packages on microcomputer systems.

### evaluation

The evaluation of computer-based materials is concerned with how well materials meet their objectives. A continuous research focus is on the reliability and validity of our review process. We also have an interest in determining the effectiveness of various computer-oriented techniques for teaching. Under what conditions are graphics effective? What is the best sequence for drill and practice exercises? What aids do students need for working with the computer? What are the measurable benefits of simulation? The broad question of the feasibility of widespread distribution of computer-based instructional material is also of more than passing interest.

### state of the art

Our discipline-oriented surveys of instructional computing report on the growth of computing and help identify needs for materials. They also tell instructors how they

may start with computing and suggest sources of information and materials. To date, 1974 and 1977 reports have been published. Data for 1979 are being analyzed for the next report to be published in early 1980.

### microcomputer investigation

Recently, with the support of the National Science Foundation, CONDUIT has begun a study of instructional materials implemented on microcomputers. This study will evaluate the instructional impact of such features as graphics, color, and audio available on some of these small systems, and the cost effectiveness of utilizing these features.



## a source of information

CONDUIT provides three types of information: general information about the use of computers in higher education; aids for authors and developers of computer-based instructional materials; and reports on CONDUIT reviewed and tested materials.

### general information about instructional computing

—*CONDUIT Pipeline* (2 times a year) A high quality publication featuring ideas for use in higher education and complete descriptions of CONDUIT's latest reviewed and tested materials. (\$3 per copy; \$15 subscription)

—*Computers in Undergraduate Teaching: 1979 CONDUIT State of the Art Reports in Selected*

*Disciplines* (\$15) Reports on how computers are used in biology, chemistry, geography, management science, mathematics, physics, political science, psychology, and sociology.

### aids for development and transfer of instructional computing materials

—*CONDUIT Author's Guide: How to Design, Develop and Package Instructional Materials for Widespread Distribution* (1978) (\$10) A well-received guide—includes CONDUIT standards for documentation and a description of the review process.

—*CONDUIT BASIC Guide* (1979) (\$10) A guide for writing and transferring programs in any BASIC dialect based on our experience, proposed standards, and a comparison of the features of over 20 BASIC dialects. Defines CONDUIT's standards for BASIC programs.

—*CONDUIT Technical Transfer Guide* (1979)  
(\$5) Guidelines to facilitate physical transfer;  
includes formats and character sets adopted by  
CONDUIT to be used for transfer between dif-  
ferent machines using different transfer media.  
(Available Spring, 1980)

**reports of reviewed and tested materials**

—*Catalog of Reviewed and Tested Materials*  
(single copy free). A complete listing of  
CONDUIT's packages, with brief abstracts.

—*Microcomputer Versions of CONDUIT*  
*Reviewed and Tested Packages* (single copy  
free). Descriptions of CONDUIT packages  
implemented on microcomputers.





## a resource for authors

If you are an author of computer-based materials, we can help you in several ways. We can offer *development advice* to help create complete, high quality, transferable packages. Our initial screening and *peer review* will also provide you with an assessment of your work

and suggestions for improvement. We will work with you to *package* your materials to CONDUIT standards including editing and printing written materials and preparing the computer elements for transfer. We will *distribute* and *maintain* your materials, a task that requires our experience with sending out computer-based materials to a variety of schools with differing computer systems. *Author recognition* follows from having materials reviewed and tested by CONDUIT. Our reputation for quality and our peer review can provide evidence of the merit of your work. We also pay royalties to individual authors.

If you want to have your materials considered for publication or distribution by CONDUIT, send us all items that would help but not overwhelm a reviewer. This includes manuals, sample sessions, a program listing, and any evaluative data you have. If you are just starting development, get a copy of the *Author's Guide*. It will help you, and could prevent problems later in the process.





## conduit organization

### central staff

CONDUIT is part of The University of Iowa; a national focus is preserved by a policy board elected by CONDUIT members. The direction and operation of CONDUIT is carried out by a full-time staff of outstanding educational computing professionals with experience in both teaching and computing. We have access to a full range of computing systems for developing, testing, and distributing materials.

### series editors

Series editors are outstanding educators in each of the academic fields covered by CONDUIT. They identify materials and conduct educational reviews of them. The editors also advise us about trends in instructional computing and write a section of our state of the art reports.



## for more information

Anyone can order CONDUIT reviewed and tested materials and receive CONDUIT publications and reports. Three types of affiliation are offered for institutions and individuals who wish to maintain an on-going relationship with us.

### members

Institutions who wish to support our effort and maintain an on-going relationship with us may become members. Members participate in the review and test process, exchange ideas with other members at workshops, review all publications, and have a voice in planning and policy making. Members pay an annual fee and designate a coordinator and a programmer who serve as a liaison to CONDUIT.

### subscribers

For individuals or centers serving a broad base of users, or for individuals interested in all aspects of instructional computing, our subscription will provide you with announcements of each new package in all CONDUIT disciplines, announcements of CONDUIT publica-

tions in our continuing series of guides and reports, and a copy of each issue of our magazine, *Pipeline*, published twice a year. The reviews and general interest articles on instructional computing in *Pipeline* will keep you abreast of developments in this dynamic field, as well as provide information critical for the selection of instructional software, from CONDUIT or elsewhere. Subscribers pay an annual fee.

### discipline groups

For individuals interested in a specific discipline area, CONDUIT will send you announcements of new packages in that discipline, and of other CONDUIT publications, such as our guides and reports. Individuals may request to receive discipline-oriented announcements specific to a single discipline free of charge.

If you are interested in CONDUIT, please write to the director.

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## a brief history of the project

*Stimulated by a deep concern about the lack of sharing of computer-based instructional ideas, five regional computer centers joined together in 1971 to form CONDUIT (Computers at Oregon State, North Carolina Educational Computing Service, Dartmouth College, and the Universities of Iowa and Texas at Austin). CONDUIT received support from the National Science Foundation to conduct a three-year experiment to identify ways of eliminating barriers to the widespread use of computing materials.*

*During the first two years over 250 college instructors participated in workshops and in monitored classroom tests. Almost 3,000 students used computer-based instructional materials selected by panels of experts and imported from other schools. The test revealed serious shortcomings in the design and documentation of existing materials.*

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*The third year of the experiment attacked the difficult task of evaluating results and testing possible solutions. Some major conclusions were that:*

- Instructors are favorable toward the use of instructional computing, largely because they see it as an essential tool for their subject;*
- Student attitudes are positive toward computing, but they fear technical details;*
- Transfer of existing materials from the originating location is costly and risky; and*
- Transfer costs and risks can be reduced by using standards for design and documentation and by reviewing materials before they are imported.*

*Encouraged by these results, CONDUIT proposed a system for the collection, evaluation and dissemination of instructional materials for use in higher education. Funding support to develop the prototype system was received from the National Science Foundation in 1975 with additional support from the EXXON Educational Foundation in 1977.*

*Today, CONDUIT, now at The University of Iowa and supported in part from revenue for services, continues its research into improving the process of distributing computer-based instructional materials.*

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a reviewed and tested package from CONDUIT  
Registry #PSY224/Psychology

# Laboratory in Cognition and Perception

C. Michael Levy; Ira S. Fischler, and Richard A. Griggs,  
University of Florida



*"This package of programs would make an excellent laboratory for a course in perception and cognitive psychology. The selection of experiments is excellent. The concepts introduced are central to such a course. The discussion questions given by the authors are very demanding. A student who successfully completed all the experiments in this package and provided acceptable answers to a majority of the discussion questions would have a grasp of cognitive psychology that equalled or exceeded the average first-year graduate student in experimental psychology."*

*From a CONDUIT Reviewer*

In an age of increasing costs and decreasing enrollment, instructors and administrators of undergraduate institutions are searching for ways to economize without compromising the quality of education. The *Laboratory in Cognition and Perception* is a cost-effective and educationally sound alternative to one of the high costs of education—psychology laboratory courses.

Direct, "hands-on" experiences in conducting research are invaluable to students of psychology. Many instructors would insist that all undergraduates engage in some of this activity. However, direct confrontations with research participants and with a large array of specialized equipment are expensive as measured in dollars, space demands, or personnel. The *Laboratory in Cognition and Perception*, a computer-based system, provides a viable alternative to traditional laboratory courses.

The *Laboratory* exposes students to a variety of phenomena, theoretical points of view, techniques, and experimental designs. Although classical problems in experimental psychology are presented, the major focus of the experiments is on contemporary research. The package may be used as a vehicle for the instructor to (1) demonstrate the use of between-subject, within-subject, and mixed designs; (2) explore the methodological decisions a researcher must make prior to collecting data; and (3) extend the student's knowledge of the processes and phenomena in contemporary human experimental psychology.

The *Laboratory* is intended to provide students with some of the skills used by cognitive psychologists in designing and conducting experiments. By performing

as both the experimenter and the subject, students experience the problems the scientist faces in asking and answering questions, and develop skills in conducting and evaluating research.

The experiments presented in the package are among the most important in cognitive psychology. The first objective of the package is to familiarize students with some of the classic studies in cognitive psychology in a way not possible through simply reading about the experiments.

The second objective is to provide students with the "hands-on" experience needed to understand the logic of experimentation, and to start students on a path which may lead to independent research. Each experiment shows how the ideas behind the experiment are realized by the particular procedures used. As students gain practice in conducting and analyzing experiments, they will develop two essential skills of a scientist: (1) understanding how each experiment simplifies complex processes; and (2) assessing to what extent this simplification was successful.

The *Laboratory* was designed to be used in a stand-alone course which parallels the substantive material covered in a lecture course in Cognition and Perception covering psychophysics, measurement and design, memory, information processing, and thinking. However, the *Laboratory* is not limited to this use, and could be used in a variety of courses including: Experimental or Cognitive Psychology; Experimental Design and Statistics (Research Methods); General Psychology (Introductory); and courses focusing on mental processes including learning, memory, thinking and conceptual processes.

The experiments are concerned with how the human information processing system actively selects information from the environment, transforms it in various ways, relates the information to previously acquired information, stores it, and retrieves it when appropriate and possible. The experiments included in the package are listed below.

1. Method of Constant Stimuli (Müller-Lyer)
2. Signal Detection (Green-Swets)
3. Span of Apprehension (Sperling)



4. Iconic Memory (Sperling)
5. Feature Detection (Neisser)
6. Pattern Interpretation (Posner)
7. Retrieval from STM (Sternberg)
8. Short-Term Forgetting (Brown-Peterson)
9. Comparing Visual and Semantic Information (Chase-Clark)
10. Concept Learning (Levine)
11. Reasoning from Prose (Frase-Griggs)

The students serve as research participants as they do in traditional laboratory courses. This experiential approach forces the students to become more involved with the subject matter than solely by reading or hearing about a method or a phenomenon. The students may also assume the role of experimenter, inviting friends to serve as subjects or assembling the data generated by their classmates.

Students can set up and run each experiment in this package quickly and may accomplish much more within a given time allotment than in a conventional laboratory. Within eleven 50-minute laboratory sessions, students can collect data on the complete set of experiments. Most of the experiments are sufficiently brief to permit several replications within one lab session and still allow for discussion of the analysis and question portions of the Student Guide. (Experiment 8, Short-Term Forgetting, however, requires almost 30 minutes at the terminal to obtain sufficient data for a meaningful analysis.)

**E**xperiment 4, Iconic Memory, is a continuance of Experiment 3, Span of Apprehension, and is based on George Sperling's partial-report research which was designed to sidestep the limits of the span of apprehension. Following is an excerpt from the Student Guide, explaining the experiment.

The logic of the procedure is similar to that used by an instructor to test how much information his students have acquired. Since one cannot ask the students to reproduce an entire text, one samples the course material in an exam. If a student answers 75% of the questions correctly, and did not know beforehand what material would be sampled, then the instructor infers (rightly, we hope!) that the student had 75% of all the material available at the time of the test.

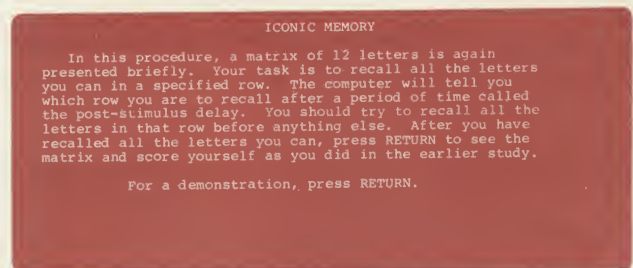
Sperling, then, had to find some way to indicate to the subject just after the stimulus was shown (and while the visual information was still available) what part of the letter array was to be reported on a given trial. This was done by presenting a tone simultaneously with the offset of the array. The tone was one of three pitches (high, moderate, or low) which informed the subject which row (top, middle, or bottom) to report. Such a signal is called a cue.

Using this procedure, Sperling found that with the four-letter rows, subjects could report, on the average, about three of the four letters. Since they were able to report three letters from any row, and did not know beforehand which row was to be cued, we can infer that, on the average, three letters of each and every row were available for report at the time just following offset of the array. This means that  $3 \times 3$ , or about nine letters, were in fact "seen" and available.

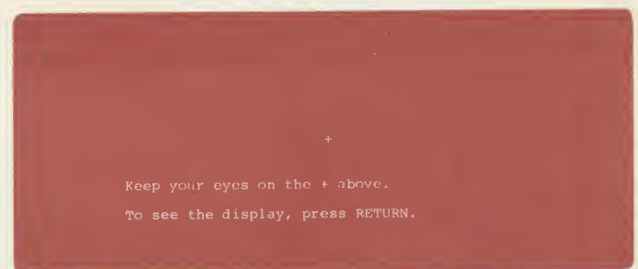
Sperling's second manipulation was to delay the tone cue so that a varying amount of time elapsed before the cue was provided. This was done to see how long the visual information persisted after the stimulus offset. At one extreme, if the image of the stimulus lasted for several seconds, it would be as if it were still being shown to the subject, and partial-report performance should remain about the estimate of span. At the other extreme, if the visual information disappeared as soon as the stimulus was removed, even slight delays in the presentation of the cue should leave the subject with only the information he would normally have in whole-report conditions, i.e., about 4.5 letters. Thus, by varying the delay of the tone cue, we can estimate the persistence of what Neisser (1967) has called "iconic memory," the brief, rapidly fading visual trace of the stimulus. Sperling found that within 500 msec, performance dropped to levels that might be expected from whole-report; that is, subjects reported only about 1.5 letters from a given row.

In Experiment 4 we will try to replicate Sperling's basic studies on partial-report and effects of delay of cue. Instead of a tone, the row to be reported will be cued visually, by the number 1, 2, or 3.

The following "screen displays" illustrate Experiment 4. The last display represents the summary report presented to the student upon completion of the experiment.



*Instructions presented. Experiment is similar to experiment 3, Span of Apprehension.*



*Fixation point for a sample trial.*

```

M W X K
V P F T
D J G R

```

Display presented briefly.

2

Write all the letters you can remember from the cued row.  
To score your response, press RETURN.

Student asked to recall Line 2.

```

M W X K
V P F T
D J G R

```

Enter your score, then press RETURN.33

It is impossible to recall 33 letters. Try again.  
Enter your score, then press RETURN.3

Now, student checks his response against the original matrix. Program keeps student honest. Or tries to.

Do you wish to review the instructions (Y or N)?N

If instructions are understood, an "N" allows forward movement.

In this experiment, you select the levels of 3 variables:

```

stimulus duration,
post-stimulus delay and
number of trials.

```

Stimulus duration (50,200,500,2000 msec):200

Post-stimulus delay (0,200,500,1000 msec):500

Number of trials (MUST be a multiple of 3):12

Student particularizes values of 3 variables.

Main experiment will now begin.

12 trials are presented to the student.

DATA FOR 3 TRIALS.  
STIMULUS DURATION: 200 MSEC.  
POST-STIMULUS DELAY: 500 MSEC.

MEAN NUMBER OF LETTERS ESTIMATED TO BE AVAILABLE FOR RECALL PER TRIAL ARE SHOWN AS A FUNCTION OF POSITION OF STARTING CUE. MEAN % OF TOTAL MATRIX SHOWN IN PARENTHESES.

| STARTING CUE POSITION |    |             |
|-----------------------|----|-------------|
| LINE 1                | 12 | ( 33.3333 ) |
| LINE 2                | 6  | ( 16.6667 ) |
| LINE 3                | 9  | ( 25 )      |

Summary presented at end of experiment.

The Laboratory package includes 5 Student Guides, Instructor Guide, and the computer programs. The package can be used with any standard textbook in cognitive psychology. With the background knowledge from the text, and the information for each experiment from the Student Guide, students should have no difficulty using the computer programs. The Student Guide prepares students to conduct the experiments as well as to guide their analyses, focus their interpretation of the data, and direct their independent reading beyond the course text.

One CONDUIT reviewer was particularly impressed with the student materials: "The authors are to be congratulated for the progression of the experiments they have incorporated. . . The mechanics of these programs from the students' point of view seems to be well thought out. . . the use of each seems to be straightforward and carefully explained in the Student Guide."

The Instructor Guide explains how the computer programs and Student Guide may be used in a laboratory course. This guide also explains how the materials may be adapted for students in other course structures with varying statistical sophistication, competency in subject matter, and time available for experimentation. It also includes suggestions to adjust and enhance the programs for a particular computer and video-display screen. Each experiment is described in



the guide by variations, limitations, and potential problems in its use. An annotated sample run of each experiment is included so that an instructor can gain full knowledge of the experiment simulation without the use of a terminal.

**T**he programs are written in a reasonably portable subset of BASIC. Dialect-specific features have been isolated as much as possible. Since recording of response latency is critical in many of the experiments, a timing function must be available within the dialect. The BASIC dialect must also be able to accept a single character from the keyboard without requiring a carriage return.

The video-display (CRT) requirements are more demanding and are likely to cause the greatest transfer problems. The CRTs used with these materials must be able to receive information at 9600 baud to effectively simulate the tachistoscopic presentations frequently used in cognitive psychology. This requirement virtually eliminates the use of these programs on most time-sharing computer systems. Single-user or real-time computers are required. (CONDUIT is preparing versions of the package for some microcomputers.)

Cursor control of the CRT must be available under program control. Specifically, cursor addressing, screen erase, and selective screen erase must be present. Lowercase letters are used throughout the programs, but are only critical for Experiment 6, Pattern Interpretation, where displaying both upper and lowercase symbols is required.

Hardcopy output of experiment summaries is highly desirable. When no hardcopy device is present, the data can be displayed on the CRT, but student time at the terminal and error rate increases significantly when they have to copy copious amounts of information.

The package includes 12 programs ranging in size from 120 to 300 lines. The programs are written in Level 1 BASIC except for response timing (TIME function) and CRT cursor and screen control (typically print ESCape sequences to the terminal such as CHR\$(27), "H" to direct the cursor to the home position).

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CONDUIT/P.O. Box 388/Iowa City/Iowa 52244

My 80

reviewed and tested packages from CONDUIT  
Registry #BIO082, BIO118, BIO122, BIO181, BIO182/Biology

# Chelsea Science Simulation Series for Biology



Chelsea Science Simulation Project  
United Kingdom

**P**erhaps the single most significant trend in education during the last decade has been the emphasis on student participation in activities of all kinds. In science teaching, this is seen in the increased emphasis given to laboratory and visual work, individual investigation, and student projects. The computer-based simulations developed by the Chelsea Science Simulation Project have been designed in the same spirit — that is, to encourage students to find out 'what would happen if . . .'. The programs which the student uses through an interactive computer terminal do more than produce a set of predetermined results. The student will need to use his own previous knowledge of the topic together with guidance given in the *Students' Notes* for each unit. This will enable him to plan a series of investigations on the simulated environment and to respond to and draw conclusions from the output.

"At one level these computer simulations can be seen as a way of providing an experience not unlike that of doing experiments which, for reasons of the expense, danger or time involved, are not otherwise possible. The simulations in no way replace real experiments but can be designed to enrich and extend work already done by students. In some respects simulation investigations have advantages over real ones in that the environment provided for the student can be carefully controlled. This means that it is possible to guide the student's inquiries towards the basic features of the (model) environment, which may be more helpful than real experiments which are subject to all the 'noise' of the real world.

"In biology a variety of situations occur where investigations are difficult or impossible for students. Though simple experiments may be practical, many interesting systems are controlled by a large number of interesting factors not easy to separate or identify without major research facilities. There are also situations where experiments need to involve vast numbers of organisms or where the time scale for an investigation is well beyond that possible for students. Such systems are found in genetics, ecology, and physiology. While the units may be used effectively by students with little knowledge of the model involved, they may also be used as a means of encouraging biologists to consider the mathematical relationships which can be used to describe the biological systems.

"The units are not intended to stand alone but rather to be viewed as an additional resource for learning integrated into existing courses; attempts have been made to make them sufficiently flexible to allow this to be achieved. No knowledge of computing is assumed on the part of either teacher or student when the materials are used, though in some later extensions an elementary knowledge may be useful."

R. Lewis, *Director*  
Chelsea Science Simulation Project

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## COEXIST—Population Dynamics

by P.J. Murphy  
Registry #BIO118

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**P**opulation dynamics is the study of the changes which occur in the size of populations over periods of time and the factors which influence these changes: it is not a topic which can easily be taught experimentally since it entails the maintenance of large numbers of organisms over many generations and is subject to the complex and not always apparent interaction of environmental and other influences. *Coexist* is an attempt to overcome these problems by providing students with the facility to simulate two biological situations. In the first, up to three populations are modeled to grow independently on identical limited food resources. The student is able to investigate the situation in which organisms compete only with members of their own species. When the outcome of such competition is familiar, *Coexist* can be used to simulate two populations in competition with each other for the same limited resources. In each of the simulations the student controls a number of parameters which might influence the outcome of competition by systematically choosing values for the numbers of offspring, generation times, initial and saturation problems, and inhibiting factors. By controlling these factors, students should learn something of their influence on population growth and of the need to set up controls and to vary only one parameter at a time in investigating relatively complex biological situations.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 315 lines of code, written in CONDUIT *Level 0* BASIC).



## COMPETE—Plant Competition

by M.E. Leveridge  
Registry #BIO182

The study of interactions between flowering plants is an important aspect of ecology, and a considerable amount of experimental work has been carried out in recent years to investigate the factors that are involved. However, experimental work with real plants often takes a long time, and such projects are not always suitable for student use. The computer simulation of plant growth presented in *Compete* enables students to plan an investigation and carry it out without the long delay usually associated with growth experiments. The *Students' Notes* describe investigations with both real and simulated plants, together with other data in the form of graphs, tables and descriptions. The real experiments need to be set up well in advance of the time when the results are required, but the others can be carried out in one or two hours. No prior knowledge about plant competition is assumed, but it is desirable that students have a general background knowledge of the development of flowering plants and of the resources which plants must obtain from their environment. The seven investigations presented in the *Students' Notes* are summarized below.

### *Effects of Crowding on Plant Growth* (real experiment).

This section contains an introductory experiment designed to show that plants do affect one another's growth when they are crowded together. It also provides an opportunity to see the actual pattern of growth of plants which are dealt with in later sections of the *Students' Notes*. The experiment needs to be set up about two weeks before the results are required.

*Measurement of Growth* (second-hand data). This section introduces the student to the quantitative measurements of growth which are used in most of the remaining investigations. The measurements show that the pattern of growth which is obtained depends upon how growth is measured.

*Simulated Growth in a Monoculture* (computer simulation). The monoculture experiments are introductory ones which familiarize students with the use of a computer to simulate plant growth. They also provide control data for comparison with the simulated growth of mixtures of different kinds of plants in a later investigation. The simulation is based on a mathematical model devised by Baeumer and DeWit.

*Interaction Between Clover Varieties* (real experiment and second-hand data). The real experiment in this section is based on one by the Nuffield Advanced Biological Science Project, and takes about two months to obtain results. The investigation of Black is also described and provides a complimentary set of data using a different species of clover. His measurements introduce the idea of a correlation between success in a mixture and the leaf area of the variety, suggesting that light is an important resource in limited supply. This idea is developed in the following section.

*Simulated Growth in a Mixture* (computer simulation). Baeumer and DeWit found that there was little or no interaction below the surface of the soil. They concluded that the light intensity was the main factor affecting competition and

that the amount of light a plant received was largely determined by its height. This section gives students an opportunity to plan an investigation to study the interaction of any two of four kinds of plants (barley, oats, tall peas, dwarf peas) at different planting densities.

*Interaction Below the Ground* (second-hand data). In this section, the work of Stern and Donald on the interaction of subterranean clover and rye-grass is presented to show the student how conditions in the soil can affect the balance between two species.

*Direct Plant Interaction* (second-hand data). The investigation described in this section is a reminder that competition for limited resources is not the only way in which plants interact. Many plants produce chemical substances which affect plants of other species nearby.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 237 lines of code, written in CONDUIT Level 0 BASIC).

## ENZKIN—Enzyme Kinetics

by M.T. Heydemann  
Registry #BIO181

A piece of experimental research requires at least three kinds of work: planning of the experiments, performance of the experiments, and interpretation of the results. Only the middle stage involves laboratory work, and it is on this stage that traditional biochemical teaching concentrates. Of course, performing experiments is important, but there is a danger that planning and interpretation may be neglected as time and resources do not permit enough laboratory work to support them.

Interpretation can be practiced with data and instructions from books, but practice in planning cannot be undertaken without the performance of many experiments. This unit permits students to obtain realistic results very rapidly, using a computer program to simulate the enzyme-catalyzed reactions. Thus, *Enzkin* allows many cycles of planning, experimentation, and interpretation over a short period of time. The educational objectives of this unit are listed below.

1) To enable students to answer for themselves some of the fundamental questions of enzyme kinetics.

2) To give students experience in dealing with an initially unknown system.

3) To provide experience in the plotting of graphs and in other forms of data interpretation. The results from the investigations they have planned seem more real than tables of data from a book, and the need to use the results in planning the next investigation encourages students to extract the meaning quickly.

4) To introduce students to some more complex situations in enzyme kinetics, such as substrate inhibition, cooperativity, and the influence of a cofactor, by using a modified version of the program.



The introduction to the *Students' Notes* describes some of the features of enzyme-catalyzed reactions. In later sections the students are asked to plot progress curves and to calculate initial velocities of reactions. Six enzymes with different properties are simulated by the computer program so that each student, or group of students, can obtain different results. Some of the enzymes may not correspond to any real phosphatase, but the principles of investigation are the same. The enzymes differ in the following six properties: Michaelis constant,  $K$ ; half the maximum velocity of reaction per ml at 30°C; optimum pH; pH range on either side of the optimum, above or below which activity falls to zero; increase in denaturation rate per 1°C rise in temperature; and temperature at which the enzyme is denatured by 0.1% per minute. These enzymes can easily be replaced by ones with different values by changing some of the data statements in the computer program.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 292 lines of code, written in CONDUIT *Level 0* BASIC).

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## EVOLUT—Evolution and Natural Selection

by S. McCormick  
Registry #BIO082

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**G**iven the complex genetic make-ups of higher organisms controlling the range of external and internal characteristics, natural selection becomes difficult to teach by traditional methods. The subject is further complicated since not all genes produce a single characteristic. In order to study the effect of natural selection on one gene (or set of alleles), the situation can be simplified by setting up a model of a wild population, in this case, the well-known Pea Model.

Unfortunately, the process of counting colored peas is too tedious, time-consuming, and error-prone to enable investigations to be carried into more than one or two generations. A far quicker means of obtaining results, without error, by the same process is by using a computer program. Set within a complete teaching package, *Evolut* is the Pea Model programmed for the computer. Students can vary the type of selection (against one homozygote, both homozygotes, the heterozygotes), the degree of selection, and the size and composition of the initial population, and then follow the course of natural selection for as many generations as desired.

The students' appreciation of the action of natural selection is enhanced by the realization that relatively small dif-

ferential survival rates are sufficient, over a number of generations, to alter the balance of a population. It will be appreciated that differential survival occurs, some forms surviving in preference to others. An elementary knowledge of genetics is assumed, particularly an understanding of (a) alleles, dominance and recessiveness, homozygotes and heterozygotes, (b) ecological habitats, and (c) percentages.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 243 lines of code, written in CONDUIT *Level 0* BASIC).

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## LINKOVER—Genetic Mapping

by P.J. Murphy  
Registry #BIO122

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**G**enetics is a part of biology in which it is sometimes difficult to arrange adequate practical work. Genetic mapping, for example, involves the breeding of large numbers of organisms which puts the practical teaching of this topic beyond the resources of most biology departments. But the understanding of genetic mapping can only be assured if the student can construct a map from breeding data. Breeding experiments themselves entail too much time and the maintenance of too many organisms for more than a trivial amount of data to be collected. On the other hand, data derived from the literature is deterministic and involves the student to only a small extent.

These problems can be overcome by simulating mapping experiments on a computer. *Linkover* has been designed to allow students to plan and execute a program of experiments so that an accurate genetic map of the single chromosome of the "electronic" species can be drawn. The student's investigation is a two-stage process: (1) selection of gene combinations either alphabetically or otherwise until the sequence of genes in the linkage group has been established; and (2) selection of adjacent genes so that the distances separating the genes can be accurately calculated. The student specifies a series of genetic crosses and from the resulting data builds up a linkage map for ten genes of a hypothetical diploid species using the three-point testcross technique. An important part of this simulation is the challenge it affords students in planning the genetic crosses themselves.

Students should have an understanding of the principles of Mendelian inheritance and should be introduced to the theory of linkage and genetic mapping before using this unit. Linkage and genetic mapping are explained in the *Students' Notes*; also included are seven exercises leading to the use of the computer simulation.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 422 lines of code, written in CONDUIT *Level 0* BASIC).



a reviewed and tested package from CONDUIT  
Registry #BIO083/ Biology

# Ecological Modeling



William Reiners, William Glanz, and Stanley Cornish  
Dartmouth College

*"The models presented here, as in all cases of ecological modeling, may seem ridiculously simple compared to the real world. One of the leading practitioners in this field, Professor Patten of the University of Georgia, has commented that the value of modeling is not the output, but the thought that goes into the modeling, and the yield of understanding which springs from this effort. It is in this same spirit that we should test and improve the models in this package."*

*From the Introduction*

The process of computer modeling and simulation can be useful tools in the analysis of ecosystems to test hypotheses and predict results from manipulating environmental factors. Because of the computer's capacity for handling large quantities of data and performing numerous arithmetic operations with speed, it is a powerful analytical tool, and it is particularly appropriate for exploring the complex problems of ecology.

The *Ecological Modeling* package introduces the student to some techniques for modeling ecological systems and processes on the computer. By controlling certain parameters, such as initial population size, growth rate, time length of the simulation, and others, the student experientially tests hypotheses and predicts results from ecosystems.

The program *Epop* calculates population size at a sequence of time intervals for a population in exponential growth. This program differs from others in this series in that the analytical solution for the differential equation of exponential growth is used. The student enters values for the initial population and growth rate and the program calculates and reports back the population size for ten time cycles. The questions at the end of the chapter challenge students to understand and identify the limitations of this model's approach.

The program *Expop* has the same objective as *Epop*, but it makes computations by a brute force method called incremental addition. With this method, population growth increments are calculated by algebraic difference equations over short periods of time. Each increment is added to the existing population, and this incremented population is then used to calculate the next growth increment. This provides a simple method for the solution of complex differential equations that are not solved readily by analytical methods. Though simple, the method is time-consuming and is only practical with a computer program. The student specifies four conditions: initial population, growth rate, number of time units to compute, and the interval of computation. The program calculates and reports the population size for ten time cycles. Following his use of the program, the student is led to compare results from *Expop* and *Epop* to determine advantages of each method of computation.

*Sigpop* is a simulation of the sigmoid, or logistic, growth model which describes the behavior of a population whose growth stops and density fluctuates around some value related to the population's environment. This model has the advantages of combining parameters describing the exponential growth characteristics of a population and the carrying capacity of the environment. However, the model describes only the growth characteristics of a population responding to negative density-dependent factors; it does not explain the actual causes of regulation, and it makes many assumptions about population structure. *Sigpop* is essentially an elaboration of *Expop* with an additional data item to be entered by the student, environmental carrying capacity. As with *Expop*, the solution to the logistic equation is effected by difference equations. The student is challenged to vary the parameters of the model to test effects of the results.

*Rand-K*, a logistic model of population growth, provides a conceptual tool for understanding growth from a lower level up to some limit of the environment. It also provides a tool for understanding population responses to changes in the carrying capacity and helps students interpret how populations are stabilized after they reach carrying capacity. One may view the expression  $(K-N)/K$  in the logistic model as a density-dependent response. It provides a varying accelerating and braking effect on growth which could represent the net effect of density-dependent factors such as competition and predation. *Rand-K* is basically a *Sigpop* model with the addition of a randomizing function to the environmental carrying capacity ( $K$ ). Fifty percent of the time  $K$  is left unchanged. The remaining fifty percent of the time  $K$  is increased or decreased by five (20% for each case) or increased or decreased by twenty (5% for each case).

Competition is a potent force in regulating ecological systems, both in terms of direct regulatory effects on component populations and in shaping the evolutionary modifications leading to specialization and niche differentiation. *Compet-1* provides students with a model to simulate these effects based on the classic Lotke-Volterra equation. Using incremental addition, the program calculates the population size of two competing species in successive time steps using data from within the program. The student enters values for the initial population size, growth rate, environmental capacity, and fraction of overlap for each population, and the number of time periods to simulate and the interval of computation. The program reports back the size of each population for the number of time periods specified by the student. An enhanced version of the program, *Compet-2*, will plot the data on any teletype-like terminal.

*Compet-5* provides a more realistic model of interspecific competition by two factors not included in *Compet-1*; (1) a randomly varying carrying capacity operating independently on the two species; and (2) a mechanism for permitting emigration and immigration. Emigration and immigration are modeled to occur in proportion to the difference between carrying capacity and the current population. If this difference is positive, immigration will occur; if negative, emigration will occur.

The last program in the package, *Tundra*, simulates the energetic relationships of an arctic tundra ecosystem. This system was chosen because of its apparent structural simplicity and because it has been studied rather extensively. By modeling such a simple system with its relatively small number of interactions, the most important relationships can be induced and applied to larger, more complex systems. For the student, *Tundra* provides an exploratory step into the complex and intricate problems of modeling ecosystems. The ecosystem and how its units are programmed in BASIC are explained in detail to give the students direct exposure to modeling and to provide them with modeling skills in their continuing studies of ecology.

One CONDUIT reviewer made the following critical comments about the package: "An immediate and obvious criticism of these simulations may be that the models are too simplistic, in that a natural system cannot be portrayed selecting only a few aspects and describing them with arbitrary mathematical equations. While this is a valid point, the objectives of the simulation must be considered. As an educational tool, an immediately complex model would camouflage many of the basic principles upon which it was founded. The approach of illustrating fundamental ecological concepts, for example, sigmoid growth patterns, and then building on them to form a more complex model of an ecosystem is preferred for yielding a better understanding of the interactions of the system."

**T**he package from CONDUIT includes three copies of the *Student Manual* and the software in machine-readable form (eight interactive BASIC programs, ranging in size from 46 to 253 lines of code, written in CONDUIT *Level 0* BASIC).



a reviewed and tested package from CONDUIT  
Registry #CHM254/Chemistry

# Chemistry Laboratory Simulations



W.M. Butler and H.C. Griffin  
University of Michigan

**T**his package of four chemistry programs will interest chemistry instructors in several ways. First, since the programs are written for the PET 2001 microcomputer, they will be of special interest to instructors using this computer. They add significantly to the instructional software base in chemistry available for the PET. A related second reason for interest is that these programs make creative and effective use of the graphics capabilities of the PET. Students find these programs more interesting to use because of the graphics and instructors who want to write PET programs of their own will find many stimulating examples of graphical techniques.

Finally, the fundamental interest in these programs will derive from their effective treatment of four basic topics in introductory chemistry: acid-base titration, reaction kinetics, oxidation-reduction, and the Bohr model of the atom. The first three programs are especially useful in conjunction with laboratory experiments, particularly when used as preparation for the laboratory. All four provide valuable supplementary treatment of topics that often cause difficulty for the introductory chemistry student.

*Titration*, a simulation of an acid-base neutralization, allows students to investigate some of the general problems encountered in a typical strong acid-strong base titration. The student's goal is to successfully determine the concentration of several unknown acids by the process of titration. The student should be familiar with the concepts of molarity, pH, indicators, titrations, and equivalence point before using the program. About twenty minutes is needed at the terminal for the average student to identify three unknowns. The author recommends that the program be used as preparation for an actual laboratory titration. From his experiences with the simulation, the student should gain a feeling for the factors involved in the laboratory procedure and the effect of the major parameters involved in a neutralization titration.

The program begins by setting up the conditions under which the reaction will be conducted: the buret holds 60 ml of base, the unknown acid is less than .800 but greater than .100 normal, and the acid is strong (greater than 90% ionized). The student must then choose the standard base concentration (molar sodium hydroxide), the volume of the unknown acid, and the pH at which the indicator should change color. At this point, the program puts some interesting graphics and animation to use. The buret and beaker are drawn and filled. As the student presses the "F" key on the terminal keyboard, the base drains from the buret and the pH (to the nearest integer) is displayed and updated

continuously. As the equivalence point is reached, the pH changes more quickly and the color can be seen to last longer in the beaker, until it changes completely. If the student has chosen a sample size and base strength combination that will either drain the buret or require too small a volume to be accurate (15 ml required minimum), the program requests a new base concentration and acid volume and

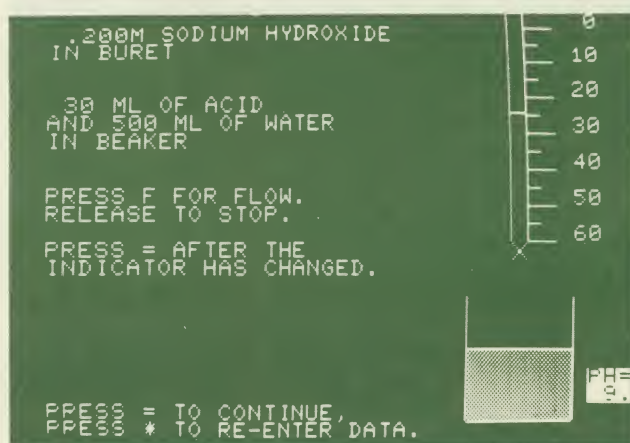


FIGURE 1. Titration

a new trial is started. If the trial is successful, the indicator changes and the student is asked to enter the buret reading and the normality of the acid. If the normality value entered by the student is within 5% accurate, the program responds with "very good" and a new unknown is given. If the value is not within 5% accurate, the formula  $M(\text{BASE}) \times V(\text{BASE}) = M(\text{ACID}) \times V(\text{ACID})$  and the correct answer are printed, followed by a new unknown. One CONDUIT reviewer stated that "Prelab practice with a simulation such as this can be very helpful in orienting students. . . I've been using something along this line for years and it does clarify a number of the potential stumbling blocks frequently encountered in the lab."

*Kinetics*, a simulation of a first order chemical reaction, allows students to calibrate a typical analytical instrument for the monitoring of a chemical reaction and then to study the factors that affect the rate of the reaction. The student's goal is to change the rate of a chemical reaction by adjusting the experimental conditions (temperature, pH) until an accurate rate constant can be determined. Before using the program,



students should be familiar with the concepts of reaction rate, reaction order, rate constant, and buffers as well as know how to determine concentrations of a colored solution spectrophotometrically and how to use logs. Approximately thirty minutes at a terminal is needed for the average student to study three unknowns. Students can gain valuable information about the effects of temperature and concentration when the program is used as a supplement to a real kinetics experiment.

The program begins by giving a brief description of the reaction being considered:  $A + B \rightarrow \text{PRODUCTS}$ , where the reaction is first order in A and reactant B is hydronium ion and is buffered. (The concentration of B is constant.) The nature of the simulated spectrometer is also explained. The option is then given to select appropriate initial conditions of

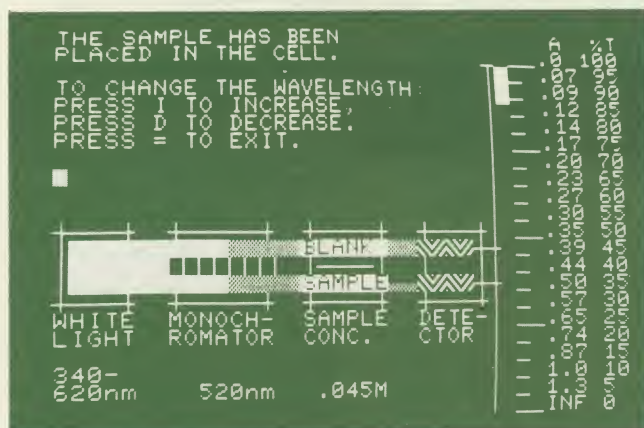


FIGURE 2. Kinetics

concentration, pH, and temperature, staying within acceptable limits on the absorbance scale. The reaction is then tracked for four minutes (simulated) and results displayed: time, absorbance, concentration of the changing reactant, and the (common) log of the concentration. The student now has the choice to: (1) plot concentration of A vs. time; (2) plot log concentration of A vs. time; (3) repeat the initial data; (4) repeat the reaction data; (5) get help on calculating the constant; (6) check his determination of the constant; (7) begin with a new reaction; or (8) re-run the reaction under different conditions. The program is rated by one CONDUIT reviewer as "highly flexible in terms of varying pH and temperature conditions, and the data display provides a vehicle for discussing many aspects of kinetics."

*Redox*, a simulation of oxidation-reduction reactions, is intended to acquaint students with the type of experimental evidence and analysis needed to rank a group of reagents (metals) in order of their power as reducing agents. After using the program, students should be able to organize a set of metals in order of their relative strengths as reducing agents. Before using the program, students should be familiar with the concepts of oxidation, reduction, oxidizing agent, and reducing agent. However, the game itself does not require detailed knowledge of electro-chemistry.

The program opens with a description of the game and definitions of notations used in the program. The program then illustrates oxidation and reduction occurring in a cell with effective graphics. One electrode is seen dissolving, and

a quantity of the other metal building up as a deposit. Once the student can tell which of the two metals is the stronger reducing agent, the graphics cease. The student is then given

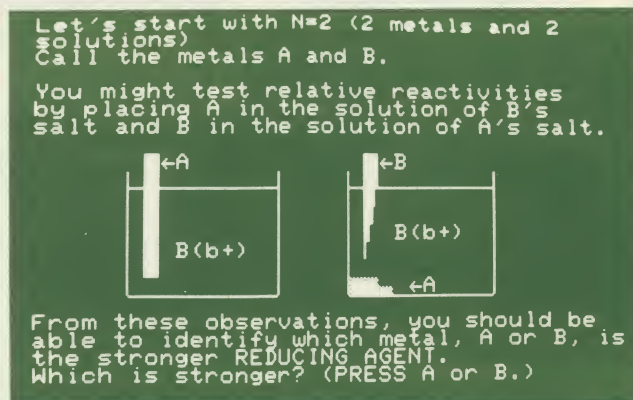


FIGURE 3. Redox

the opportunity to work with other pairs of metals, observe which dissolves in which ion solution, and then rank them in decreasing order of reducing strength.

*Bohr Atom* is a simulation of the Bohr model of one-electron hydrogen-like atoms. The program is intended to help students better understand the nature of electrostatic attraction forces in an atom by the investigation of the behavior of an electron about a positively charged nucleus (as described by the Bohr model). After using this program, students should be able to describe in common terminology (and energy units) the behavior of an electron in a single atom. Before using the program, students should be familiar with the concepts of quantum number, electron shells, nuclear charge, photons, electronic transition, absorption, emission, and the energy units of electron volts and wave-numbers. All of the equations and constants necessary are provided in the program's help routines.

The program begins with a graphical display showing an excited atom and the successive emissions of photons as the electron drops to lower and lower energy levels. A table is then presented associating wave numbers with transitions, followed by a series of questions concerning these transitions. A transition is then displayed and the student must identify it as indicating absorption or emission of energy, with an appropriate remedial message if the answer given is incorrect. More transitions are shown and the student is asked to calculate the quantum number, the energy of the electron, the energy of the photon, the radius of the electron's orbit, and the nuclear charge Z.

The package from CONDUIT includes one copy of the Instructor's Guide (40 pages) and the four programs on cassette or diskette for the PET 2001 microcomputer.



reviewed and tested package from CONDUIT  
Registry #PHY129, PHY130, PHY183/Physics

# Chelsea Science Simulation Series for Physics



Chelsea Science Simulation Project  
United Kingdom

**P**erhaps the single most significant trend in education during the last decade has been the emphasis on student participation in activities of all kinds. In science teaching, this is seen in the increased emphasis given to laboratory and visual work, individual investigation, and student projects. The computer-based simulations developed by the Chelsea Science Simulation Project have been designed in the same spirit — that is, to encourage students to find out ‘what would happen if . . .’ The programs which the student uses through an interactive computer terminal do more than produce a set of predetermined results. The student will need to use his own previous knowledge of the topic together with guidance given in the *Students’ Notes* for each unit. This will enable him to plan a series of investigations on the simulated environment and to respond to and draw conclusions from the output.

“At one level these computer simulations can be seen as a way of providing an experience not unlike that of doing experiments which, for reasons of the expense, danger or time involved, are not otherwise possible. The simulations in no way replace real experiments but can be designed to enrich and extend work already done by students. In some respects simulation investigations have advantages over real ones in that the environment provided for the student can be carefully controlled. This means that it is possible to guide the student’s inquiries towards the basic features of the (model) environment, which may be more helpful than real experiments which are subject to all the ‘noise’ of the real world.

“Physics has to do with the real world but in some cases an actual experiment is not possible; for example, nuclear scattering and the motion of space probes. However, physics also has to do with building models to describe the real world: the nuclear atom, the inverse square force of gravity. Now it is unfortunately the case that in applying a model to a real situation, the mathematical manipulation involved often looms as large in our teaching as the model itself or the phenomena it explains. (For example, finding the correct similar triangles and making the approximations in the application of the wave model of light to account for Young’s fringes.) By creating a simple physical model or perhaps a variety of models in the computer program and letting the student investigate the behavior predicted by the model(s) under different conditions it is possible to focus the student’s attention on this essential aspect of physics as model building.

“The units are not intended to stand alone but rather to be viewed as an additional resource for learning integrated into existing courses; attempts have been made to make them sufficiently flexible to allow this to be achieved. No

knowledge of computing is assumed on the part of either teacher or student when the materials are used, though in some later extensions an elementary knowledge may be useful.”

R. Lewis, *Director*  
Chelsea Science Simulation Project

## INTERP—Wave Superposition

by J. Harris  
Registry #PHY183

**T**his unit on wave superposition is designed to improve students’ understanding of the use of models in physics. The unit is built around the wave theory of light and attempts to show students how effective the theory is in explaining observed phenomena. *Interp* is not intended to replace the usual teaching of interference and diffraction phenomena. It cannot in any way replace actual observation of these patterns which are after all easily enough seen using simple laboratory equipment. The aim is quite different: to focus students’ attention on the physical model used to explain the observations in a way that, because of the mathematics involved, is not simple to do without a computer. The unit is intended to encourage a more critical attitude to the use of models in physics in general, by emphasizing and investigating some of the assumptions (nearly always made but hardly ever mentioned) in this one example. It is a general awareness of this aspect of physics as much as any particular lessons about physical optics that it is hoped will be achieved.

The *Students’ Notes* provide information that guides the student through three investigations of interference and diffraction phenomena using the computer program. After some introductory (revision) questions the student is invited to use the program to predict the intensity distribution given by two (equal intensity, in phase) sources of monochromatic radiation. This is intended as a preliminary exercise to show that the program works, that is, gives sensible results for a situation where the student knows what to expect. The second investigation is to use two slits of finite width instead of two sources. It is hoped that students will see that this computer prediction is closer than the previous one to what is observed in a two-slit experiment with light or 3 cm radio waves. Students are told that the usual treatment of these effects



(based on Huygens' principle plus wave superposition) involves some simplifications, and they are challenged to think what these are. The *Notes* also raise the question of how many secondary sources must be considered to make an adequate prediction.

Each of these factors is discussed briefly and in the third investigation students are invited to explore the effect of each one on the predicted intensity pattern in a two-slit experiment. They are asked to compare these various predictions with measurements made using 3 cm radio waves and to make judgments about the importance of the different factors for this experiment and also for a Young's experiment using visible light. The work so far has been restricted to variations along a line parallel to the slits or sources. As an optional extension of their work, students can explore variations along a line perpendicular to the slits or sources.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 284 lines of code, written in CONDUIT *Level 0* BASIC).

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## SCATTER—Particle Scattering

by J. Harris  
Registry #PHY129

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**P**hysics has to do with the real world, but in some cases, an actual experiment is impossible to carry out in the real world. One example deals with nuclear scattering, an experiment which reveals the shape and size of an object which cannot be seen. Since there are experimental difficulties in performing certain scattering investigations, models of a number of experimental situations have been programmed for a computer simulation. By working with these models, students will be able to gain considerable insight into these scattering experiments which are so important in physics.

There are three computer programs in the *Scatter* unit which simulate various systems. The first two give students experience in deducing the size, shape, and force law of a single scattering center from the scattering pattern it produces. The third program simulates the scattering of alpha particles by a metal foil. Furthermore, by creating a simple physical model, or perhaps a variety of models, in the computer program and letting the student investigate the behavior predicted by the models under the different conditions, it is possible to focus students' attention on this essential aspect of physics as model building.

The educational aims of *Scatter*, as stated by the author, are to: show students that one can learn about the nature (shape, size, etc.) of an object from the way it scatters particles; increase their understanding of the use of models in physics; and give some appreciation of the work of Rutherford, Geiger, and Marsden.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the

software in machine-readable form (three interactive BASIC programs, ranging in size from 142 to 178 lines of code, written in CONDUIT *Level 0* BASIC).

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## NEWTON—Satellite Orbits

by J. Harris  
Registry #PHY130

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**N**ewton suggested that a stone thrown with sufficient speed from the top of a mountain would go into orbit around the earth. While students are unable to attempt this experiment, a computer can be used to work out what would happen if it was performed. The computer program on which this unit is based uses an iterative method to calculate the path of a projectile launched horizontally. Using the program, students are able to investigate how the path taken depends on the height of the mountain and the initial speed. The student is challenged to find the initial velocity needed for the minimum (circular) orbit, and to compare the period and shape of orbits of different sizes with data for earth satellites. More specifically, the simulation encourages students to think about the relationship between models (in this case, Newton's Law of Gravitation and his Second Law of Motion) and the physical phenomena these models explain.

The objectives which might be achieved with this unit include:

- 1) extending students' knowledge of projectile motion from the simplest case (a "flat earth" and constant gravitation force), to the more general (round earth, force varying with distance);
- 2) an appreciation of how the application of Newton's second law, and his law of gravitation leads to the prediction of satellite orbits;
- 3) knowledge of the possible shapes of orbits;
- 4) some idea of the periodic time of orbits, and of the effect on the orbit of varying launch velocity;
- 5) the application of a familiar idea (conservation of energy) in a new situation;
- 6) thinking about the relationship between a simplified model and the actual situation it is used to describe; and
- 7) an appreciation of the use of a computer to solve a problem which students cannot solve analytically.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 134 lines of code, written in CONDUIT *Level 0* BASIC).

My 80



- ☐ Which microcomputers are you preparing programs for?  
And will every program be available for each of these micros?

Specific micro versions may have characteristics peculiar to that system. Since a translated version for another micro would eliminate these special traits, a version for each micro often is not desired. Also, we prefer to release micro versions as soon as possible, rather than wait for versions to be written for the other systems. (Check the order form with this brochure for a list of the packages for each micro.)

- Definitely. We like to know if a customer is successful in installing a package on *any* system. And in the case of micros, we would like to review your version for possible redistribution to others. The potential reward: credit toward purchase of other packages. ➤

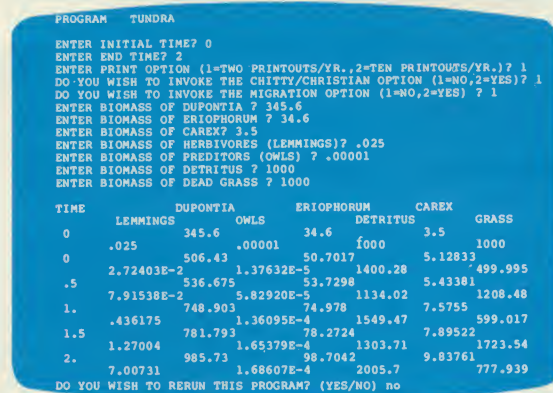


## What's Special about the New Releases for Microcomputers?

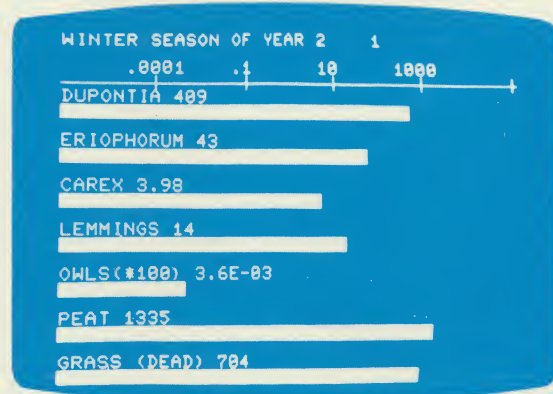
Customers who order CONDUIT packages in their standard BASIC or FORTRAN form receive a reel of magnetic tape from which they load the software onto the local computer system. The tape is recorded to their specifications so that loading the programs should go smoothly. But after the software is loaded, a program typically requires minor modifications before it is ready to run.

The most obvious difference to the buyer of a micro version of a CONDUIT package will be that the software comes on a small cassette or diskette instead of a large reel of tape. And once loaded, the programs should run immediately because they have been tailored specifically for that computer system.

What really sets the micro versions apart, however, is that they utilize such special features as graphical output. This article describes and illustrates some of the features employed in the Commodore PET versions of several CONDUIT packages. (APPLE II and TRS-80 versions have similar characteristics.)



Standard Tabular Output of the Tundra Program  
(Ecological Modeling)  
FIGURE 1

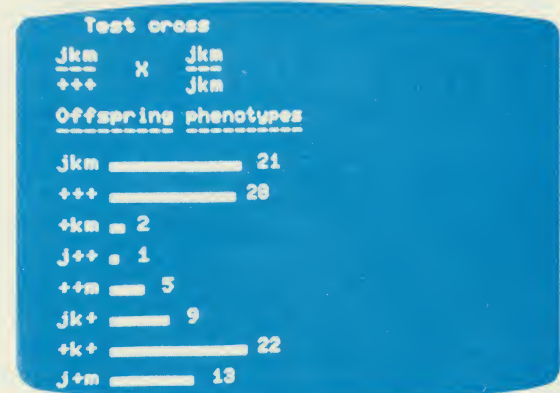


Bar Graph Output from the Micro Version of Tundra  
(Ecological Modeling)  
FIGURE 2

A dramatic illustration of the differences between standard BASIC and microcomputer forms of CONDUIT programs can be seen in the comparison of the standard tabular output of the *Tundra* program (from *Ecological Modeling*) and the bar graph output in the micro version (see Figures 1 and 2). *Tundra* simulates the growth, decay and interaction of six different species in an arctic tundra ecosystem. In the micro program, as new biomass values are computed for each species in a cycle of the simulation, the length of the corresponding bar in the graph is dynamically altered. The simulation can be left to cycle through month after month and year after year to observe the system dynamics, or it can be interrupted at any point with a single key stroke, and the user can specify new biomass values for any species to investigate how the ecosystem will respond to the change. Similar operations can be carried out in the standard *Tundra*, but only by much more cumbersome means.

Having programs respond to a single key stroke (no RETURN required), as in *Tundra*, is achieved in microcomputer BASIC through the GET statement. This statement makes use of a one-character buffer which is receptive to user input at any time, not just when the user is specifically being prompted for input. The effect is somewhat like that of hitting the "break" key, except that the program is not aborted (as is often the case with break), and there can be a programmatic response based on which key the user has pressed. When the feature is used effectively, as we believe it is in *Tundra*, the user feels that the program is much more responsive.

The type of bar graph display used in *Tundra* is certainly not restricted to microcomputers. Many CRT terminals used on timesharing systems could do the same or better. But the programming techniques for building a bar graph vary significantly from terminal to terminal and no single terminal is sufficiently wide use in the educational community to merit a specially tailored version of a software package. CONDUIT has not used other low resolution plotting methods for similar reasons. Some of these techniques, now fully accepted by CONDUIT for the specialized microcomputer releases, are illustrated in the remaining figures.



Relative Phenotype Frequencies from a Genetic Crossover Experiment (Linkover)  
FIGURE 3



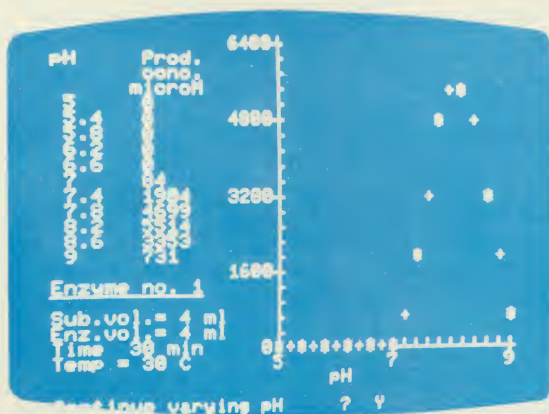
Figure 3 is another bar graph showing relative phenotype frequencies in a genetics experiment from the *Linkover* package. The principal enhancement that the micro version of this program offers is that the bar graph is built up dynamically as the results of the simulated experiment are computed. This corrects an annoying delay in the standard version. Furthermore, if the student quickly perceives the "shape" of the results, he can terminate the experiment and start another.

Figure 4 shows the output of a wave interference experiment from the physics package *Interp*. Even with the low resolution graphics used here, the features of the interference pattern are clear. The standard version simply gives results in a table. A further convenience of the micro version is that a replica of the slit mask used to produce the interference pattern is displayed for reference at the top of the screen.



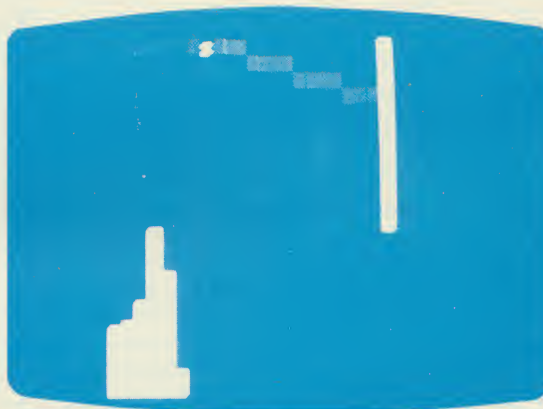
Output for a Two-slit Diffraction Experiment (*Interp*)  
FIGURE 4

The micro version of the enzyme kinetics program *Enzkin*, illustrated in Figure 5, improves upon the standard form by providing tabular and plotted data side by side.



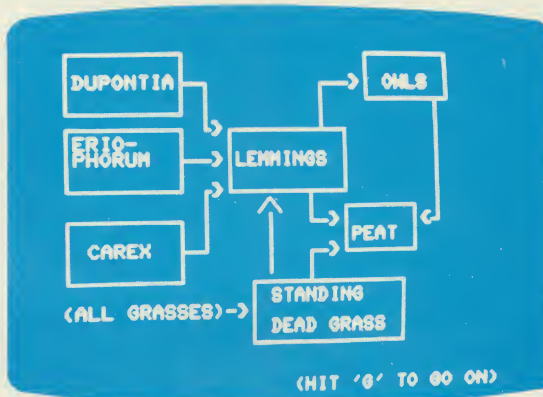
Results of Simulated Action of an Enzyme on its  
Substrate (*Enzkin*)  
FIGURE 5

Some of the micro versions use the graphics capabilities for more than simply plotting numeric data. The physics program *Scatter* simulates scattering experiments in which projectiles are scattered by various angles after they have impinged on a target of unknown shape. As shown in Figure 6, the micro version of *Scatter* shows the student each projectile as it is fired and scattered, while the number of projectiles scattered through different angles is accumulated in a simultaneously displayed histogram. This is strikingly different from the straight tabular output from the standard form of *Scatter*.



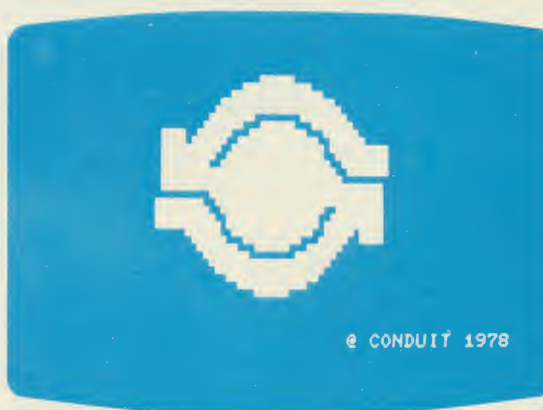
Simulated Particle Scattering Experiment with a  
Histogram of Scattering Frequencies at Different  
Angles (*Scatter*)  
FIGURE 6

Another use of graphics is illustrated again by *Tundra* in Figure 7, which shows a flowchart for the simulated arctic community.



Interaction Among Species for the Tundra  
Simulation (*Ecological Modeling*)  
FIGURE 7

Finally, CONDUIT staff could not resist this first real opportunity to have programs display a replica of our logo.



© CONDUIT 1978

## Microcomputers: Innovation in Education

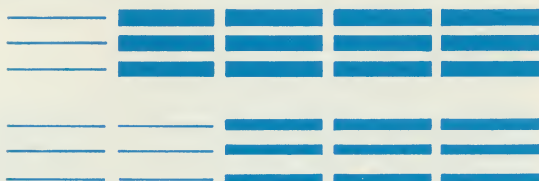
CONDUIT has launched two major new projects involving microcomputers. The first project is funded by the National Science Foundation and will consist of two phases: an eighteen-month experiment followed by a dissemination period in which both the findings from the experiment and certain of the materials developed will be made available. The experiment will compare the instructional effectiveness of some existing computer-based instructional units with counterparts that have been converted to run on microcomputers. The micro versions

will be designed to take advantage of features such as graphics displays, color, audio, and various types of input devices. Subject areas for these units are mathematics, physics, chemistry, and biology. Topics in advanced undergraduate instruction will be emphasized. Selected materials developed for the experiment will be distributed through CONDUIT's existing international distribution system.

The second project, supported by the Fund for the Improvement of Postsecondary Education, immediately focuses on the need for dissemination of instructional innovation. Recognizing that the use of computers in education has fallen far short of its potential, CONDUIT will identify and disseminate thirty-five microcomputer-based instructional modules in a variety of disciplines, including the humanities and the social sciences. A principal outcome of the project will be the impact on future development of materials by providing examples, guidelines, and standards formulated during the project.

Both projects are ambitious in scope and will require the cooperation and assistance of many individuals outside the CONDUIT central staff. In particular, authors of microcomputer-based materials are needed. CONDUIT also needs reviewers and test sites. For further information, please contact Hal Peters, Associate Director, CONDUIT, P.O. Box 388, Iowa City, Iowa 52244 (319-353-5789).

## CONDUIT—A Reliable Source of Instructional Materials



CONDUIT distributes computer-based instructional materials that are reviewed, well-documented, programmed for ease of transfer, and kept up-to-date. All of the instructional materials are peer reviewed for conceptual validity, instructional usefulness, and overall quality. Series editors in each of our disciplines coordinate the reviews and advise CONDUIT concerning the educational elements of each package we distribute. The CONDUIT staff also technically reviews each program for accuracy and transferability to a wide range of computing systems. Materials are currently available for use in biology, chemistry, economics, education, geography, humanities, management science, mathematics, physics, political science, psychology, sociology, and statistics.

A typical CONDUIT reviewed and tested package consists of a computer program written in BASIC or FORTRAN, a student guide explaining objectives and methods of use, an instructor guide illustrating course use, notes describing installation of the materials on the computer, and the programs in a form that can be read by your computer. CONDUIT has also recently begun distributing microcomputer versions of some of its packages.

CONDUIT has gained an international reputation for its distribution of materials and has been referred to as the best source of computer-based instructional materials. If you order our materials and find them unsuitable, you may return them. Our return rate is less than 2 percent.



☐ Please send me the following materials for my  
**Radio Shack TRS-80**  
 Mini Disk for TRS-80  
 (Level II BASIC, DOS, 32K)

|                                                     | Qty. | Unit Price | Total |
|-----------------------------------------------------|------|------------|-------|
| <input type="checkbox"/> <b>EVOLUT</b>              |      |            |       |
| Package                                             | —x   | \$30.00    | —     |
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| Students' Notes                                     | —x   | 1.50       | —     |
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| Package                                             | —x   | \$60.00    | —     |
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| <input type="checkbox"/> <b>LINKOVER</b>            |      |            |       |
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| Students' Notes                                     | —x   | 1.50       | —     |
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| Students' Notes                                     | —x   | 1.50       | —     |
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| <input type="checkbox"/> <b>COMPETE</b>             |      |            |       |
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| Students' Notes                                     | —x   | 1.50       | —     |
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| Students' Notes                                     | —x   | 1.50       | —     |
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|--------------------------------------------------------------------------|----|----------|---|
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| Package                                                                  | —x | \$30.00  | — |
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| Students' Notes                                                          | —x | 1.50     | — |
| Teachers' Guide                                                          | —x | 1.50     | — |
| <input type="checkbox"/> <b>SCATTER</b>                                  |    |          |   |
| Package                                                                  | —x | \$30.00  | — |
| Add'l Micro Media                                                        | —x | 10.00    | — |
| Students' Notes                                                          | —x | 1.50     | — |
| Teachers' Guide                                                          | —x | 1.50     | — |
| <input type="checkbox"/> <b>NEWTON</b>                                   |    |          |   |
| Package                                                                  | —x | \$30.00  | — |
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| Students' Notes                                                          | —x | 1.50     | — |
| Teachers' Guide                                                          | —x | 1.50     | — |
| <input type="checkbox"/> <b>INTERP</b>                                   |    |          |   |
| Package                                                                  | —x | \$30.00  | — |
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| Students' Notes                                                          | —x | 1.50     | — |
| Teachers' Guide                                                          | —x | 1.50     | — |
| <input type="checkbox"/> <b>LABORATORY IN COGNITION &amp; PERCEPTION</b> |    |          |   |
| Package                                                                  | —x | \$100.00 | — |
| Add'l Micro Media                                                        | —x | 10.00    | — |
| Student Guide                                                            | —x | 5.00     | — |
| Instructor's Guide                                                       | —x | 8.00     | — |
| <input type="checkbox"/> <b>CHANGE AGENT</b>                             |    |          |   |
| Package                                                                  | —x | \$35.00  | — |
| Add'l Micro Media                                                        | —x | 10.00    | — |
| Student Guide                                                            | —x | 2.00     | — |
| Instructor's Guide                                                       | —x | 3.00     | — |
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| Package                                                                  | —x | \$40.00  | — |
| Add'l Micro Media                                                        | —x | 10.00    | — |
| Instructor's Guide                                                       | —x | 3.00     | — |

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**Apple II**  
 Disk II Floppy Disk  
 (Applesoft in ROM, DOS, 48K)

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| Add'l Micro Media                                   | —x   | 10.00      | —     |
| Students' Notes                                     | —x   | 1.50       | —     |
| Teachers' Guide                                     | —x   | 1.50       | —     |
| <input type="checkbox"/> <b>ECOLOGICAL MODELING</b> |      |            |       |
| Package                                             | —x   | \$60.00    | —     |
| Add'l Micro Media                                   | —x   | 10.00      | —     |
| Student Guide                                       | —x   | 5.00       | —     |
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| Package                                             | —x   | \$30.00    | —     |
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| Teachers' Guide                                     | —x   | 1.50       | —     |
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| Package                                             | —x   | \$30.00    | —     |
| Add'l Micro Media                                   | —x   | 10.00      | —     |
| Students' Notes                                     | —x   | 1.50       | —     |
| Teachers' Guide                                     | —x   | 1.50       | —     |
| <input type="checkbox"/> <b>ENZKIN</b>              |      |            |       |
| Package                                             | —x   | \$30.00    | —     |
| Add'l Micro Media                                   | —x   | 10.00      | —     |
| Students' Notes                                     | —x   | 1.50       | —     |
| Teachers' Guide                                     | —x   | 1.50       | —     |
| <input type="checkbox"/> <b>COMPETE</b>             |      |            |       |
| Package                                             | —x   | \$30.00    | —     |
| Add'l Micro Media                                   | —x   | 10.00      | —     |
| Students' Notes                                     | —x   | 1.50       | —     |
| Teachers' Guide                                     | —x   | 1.50       | —     |



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☐ **HABER**  
 Package —x \$30.00 —  
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 Teachers' Guide —x 1.50 —

☐ **SCATTER**  
 Package —x \$30.00 —  
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Please send me the following materials for my  
☐ **Commodore PET 2001 (8K)**  
☐ diskette or ☐ cassette for Commodore  
 Model 2040 or Model 2041 Floppy Disk  
 systems

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| Package —x                             |      | \$30.00    | —     |
| Add'l Micro Media —x                   |      | 10.00      | —     |
| Students' Notes —x                     |      | 1.50       | —     |
| Teachers' Guide —x                     |      | 1.50       | —     |

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 Student Guide —x 5.00 —

☐ **COEXIST**  
 Package —x \$30.00 —  
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 Students' Notes —x 1.50 —  
 Teachers' Guide —x 1.50 —

☐ **LINKOVER**  
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☐ **ENZKIN**  
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 Add'l Micro Media —x 10.00 —  
 Students' Notes —x 1.50 —  
 Teachers' Guide —x 1.50 —

☐ **INTERP**  
 Package —x \$30.00 —  
 Add'l Micro Media —x 10.00 —  
 Students' Notes —x 1.50 —  
 Teachers' Guide —x 1.50 —

☐ **CHEMISTRY LABORATORY SIMULATIONS**  
 Package —x \$40.00 —  
 Add'l Micro Media —x 10.00 —  
 Teacher's Guide —x 2.00 —

SUBTOTAL \_\_\_\_\_

TOTAL \_\_\_\_\_

- ☐ What happens if I order a micro version of a CONDUIT package and I can't read the cassette or diskette on my system?

If a cassette is sent with your package, it will have two copies of each program, one on each side of the cassette. If you can't read either side, return it (within 60 days) and we will send a replacement. If you can't read the replacement, you have two options. You may return the complete package for a full refund or you may return the media only and request the program listing of the micro version to key in the programs yourself.

Fortunately for purchasers of materials on diskettes, problems with reading diskettes appear to be minimal.

- ☐ Why are micro versions of CONDUIT packages priced the same as the other versions supplied on the large magnetic tape reels? Aren't cassettes and diskettes a lot cheaper than the large reels?

Media for micros are indeed somewhat less expensive than the large tape reels. But when we consider all costs involved, the micro versions cost about the same to produce and distribute as the other versions.

- ☐ Our physics department has three micros, all from the same manufacturer. If we order the INTERP package on a cassette, can we use it on all three machines?

Yes, but depending upon the location of the machines, you might want to consider ordering additional cassettes or diskettes with your original order which would give you media for each of the systems.

- ☐ Our physics department purchased a micro version of INTERP. Are other departments on our campus permitted to use our cassettes?

- ☐ Yes, but make it clear to them that you have signed an agreement that prohibits copying for redistribution. If they want a copy of their own, you should order extra copies for them. You should also keep in mind that such usage by departments other than the purchaser is restricted to the site for which the package was originally purchased.

- ☐ Our school ordered three CONDUIT packages for our timesharing system last year. Now my department is buying a microcomputer and I want to move the packages to the micro. Do I have to order the packages again?

Not necessarily, but you must write CONDUIT for permission to transfer a package from the CPU designated in your original order to a CPU of a different make.

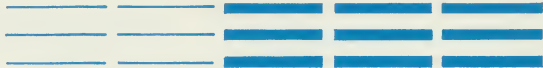
- ☐ If my micro is equipped with a communication interface to the mainframe system, can I "download" a CONDUIT package to my micro?

Not without written permission. Again, you should write to CONDUIT requesting special authorization for making the transfer.

- ☐ Would it ever be to my advantage to simply reorder a package for use on a micro, even though it is already installed on the campus mainframe computer system?

Yes. The transfer task is often nontrivial; our versions remove these transfer problems and often include significant improvements, such as graphics. The cost of the micro versions is sufficiently low, we feel, to make repurchase advantageous.

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**Mail to:**

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CONDUIT orders are usually shipped via United Parcel Service. Shipping and handling charges (averaging \$2 per unit) will be added to the TOTAL. **To avoid shipping and handling charges please prepay.** Orders mailed outside the continental U.S. will be charged actual shipping and handling, with no exceptions. These orders will be mailed surface U.S. mail unless otherwise specified (average two month delivery).

Please return completed form to: CONDUIT, P.O. Box 388, Iowa City, Iowa 52244.

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reviewed and tested packages from CONDUIT  
Registry #CHM160, CHM199/ Chemistry

# Chelsea Science Simulation Series for Chemistry

Chelsea Science Simulation Project  
United Kingdom



**"P**erhaps the single most significant trend in education during the last decade has been the emphasis on student participation in activities of all kinds. In science teaching, this is seen in the increased emphasis given to laboratory and visual work, individual investigation, and student projects. The computer-based simulations developed by the Chelsea Science Simulation Project have been designed in the same spirit — that is, to encourage students to find out 'what would happen if . . .' The programs which the student uses through an interactive computer terminal do more than produce a set of predetermined results. The student will need to use his own previous knowledge of the topic together with guidance given in the *Students' Notes* for each unit. This will enable him to plan a series of investigations on the simulated environment and to respond to and draw conclusions from the output.

"At one level these computer simulations can be seen as a way of providing an experience not unlike that of doing experiments which, for reasons of the expense, danger or time involved, are not otherwise possible. The simulations in no way replace real experiments but can be designed to enrich and extend work already done by students. In some respects simulation investigations have advantages over real ones in that the environment provided for the student can be carefully controlled. This means that it is possible to guide the student's inquiries towards the basic features of the (model) environment, which may be more helpful than real experiments which are subject to all the 'noise' of the real world.

"Situations frequently occur in chemistry teaching where it is not practical for students to complete a full investigation of a system due to shortage of time. Practical experience of modern chemical equipment or of industrial conditions are usually well beyond the scope of a teaching laboratory. Computer simulation is able to make a contribution in both these areas and at the same time can be designed to involve students in the design of experiments in a way that is rarely possible in practical courses.

"The units are not intended to stand alone but rather to be viewed as an additional resource for learning integrated into existing courses; attempts have been made to make them sufficiently flexible to allow this to be achieved. No knowledge of computing is assumed on the part of either teacher or student when the materials are used, though in some later extensions an elementary knowledge may be useful."

R. Lewis, *Director*  
Chelsea Science Simulation Project

## RKINET—Reaction Kinetics

by A.W.B. Aylmer-Kelly  
Registry #CHM160

**T**he laboratory can be used for a few experiments in reaction kinetics, but some especially interesting reactions often have to be omitted for reasons of time or complexity. This simulation, or model, has been written with the aim of fulfilling two basic objectives: (1) to extend students' laboratory experience and understanding of reaction kinetics by enabling them to carry out a wider range of investigations without taking up an excessive amount of time; and (2) to help students understand the relationship between a mathematical model and reality.

This unit makes use of a computer program in which a series of mathematical equations (a mathematical model) represents the ways in which various factors influence the rate of a chemical reaction. The simulation model, which is based on data from real experiments, will broaden the students' knowledge of first- and second-order reactions, rate constants, concentration, and the effect of variation of temperature on reaction rate.

The student first carries out a simple exercise in mathematical modeling, comparing computer-derived results with his or her own experimental ones. The student then uses models, stored in the computer program, to simulate other experiments, choosing suitable values for parameters which represent experimental conditions. This gives the student valuable experience in designing such experiments and a practical knowledge of characteristics of chemical systems which might not be obtained in any other way.

The use of the simulation also provides experience in selecting investigations which produce meaningful results. However, it is not intended in any way to replace existing laboratory experiments, but rather to complement and extend the students' work.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 245 lines of code, written in CONDUIT Level 0 BASIC).

## HABER—Ammonia Synthesis

by R. Edens and K. Shaw  
Registry #CHM199

The production of ammonia by the Haber process is an important process in chemical industry, and yet one not easily performed by students in conventional laboratory investigations. The *Haber* computer simulation provides students with the opportunity to study the Haber process and how the various conditions (temperature, pressure, catalyst and reactant concentration ratios) influence the course of the reaction (i.e., the time required to reach equilibrium yield of ammonia). Specifically, the authors state that the objectives of the unit are to enhance students' understanding of:

- (1) The Haber process.
- (2) The effects on the equilibrium yield of ammonia of changing temperature, pressure, and the initial hydrogen-to-nitrogen molar ratio.
- (3) The effects on the reaction rate of changing temperature and pressure.
- (4) The effects on the reaction rate using various catalysts.
- (5) Some of the considerations outside chemistry which have to be taken into account in the design of chemical plants for the industrial production of ammonia.
- (6) The interpretation of results predicted in a model for conditions which the students are unable to create in the laboratory.
- (7) The use of a mathematical model.

Even though the computer simulation is interactive, it does not stand alone. The *Students' Notes* provide the essential framework and direction for the students' studies. The *Notes* provides a brief restatement of the equilibrium law, Le Chatelier's Principle of Equilibrium, the rate law of kinetics, the ammonia synthesis mechanism, the effect of temperature on the rate constant, and the effects of catalysts. Before using this unit, students should be introduced to these concepts through lectures and textbook readings. Armed with this knowledge, students can use the *Haber* simulation to investigate the properties of a system at equilibrium (Investigation #1) and to investigate the kinetics of the Haber process (Investigation #2).

In Investigation #1 the student specifies the constant molar ratio, the initial temperature, the increase in temperature, and the constant pressure, and selects to vary the pressure, temperature, or initial hydrogen-to-nitrogen ratio. The computer program then calculates and displays the percentage yield of ammonia against the varying parameters for the conditions chosen by the student.

In Investigation #2 the student specifies which catalyst to use (none, osmium, tungsten, molybdenum, iron, or manganese dioxide) and then chooses a temperature and pressure for the investigation. At time intervals set by the student, the simulation calculates the amount of ammonia formed, expressed as a percentage of ammonia in the equilibrium mixture.

Each investigation is followed by questions to bring out the important points of the chemistry.

The package from CONDUIT includes six copies of the *Students' Notes*, one copy of the *Teachers' Guide*, and the software in machine-readable form (one interactive BASIC program, 308 lines of code, written in CONDUIT Level 0 BASIC).



a reviewed and tested package from CONDUIT  
Registry #SOC156/ Sociology

# PROFIS Programs for Introductory Sociology

George H. Conklin, North Carolina Central University



*"The Profis package is a rare example of a tutorial program in sociology. It is brief – students can complete the exercise on the computer terminal in about a half-hour – and yet it conveys much information and holds students' attention, according to instructors who have used it. While the package may not be exemplary relative to materials in other disciplines, it is an important package because it will serve as a model for the type of minipackages, miniprojects which are needed in sociology."*

Ronald Anderson  
CONDUIT Series Editor for Sociology

**D**r. Conklin believes that "One of the recurring problems facing the instructor in introductory sociology courses is how to introduce students to the ways in which sociologists study the world around them." Dr. Conklin points out that many introductory sociology texts either omit all references to methodology, or they give only minimal attention to sociological techniques. In attempting to help alleviate this problem, Dr. Conklin has developed a series of computer-assisted teaching modules called *PROFIS*. These brief tutorials combine relevant content areas and introductory methodology in simple, easy-to-use computer-assisted homework assignments.

*PROFIS I* discusses social facts that cause changes in birth rates. Through the example of the world population problem, the student explores the strength of relationships between birth rate and indicators, such as per capita income, by summarization in contingency tables and correlation measures (specifically Yule's Q).

*PROFIS II* is concerned with the study of crime and with the determination of social indicators of crime. The concept of correlation between crime and social indicators such as poverty, city finances, and population density are extended to predicting crime through linear multiple regression.

*PROFIS III* illustrates the use of growth curves in the context of urbanization. Using New York City as a model, the student learns about the accuracy of prediction of urban growth through linear, exponential, and s-shaped (logistic) curve models.

Each tutorial begins by introducing the student to the substantive issues involved. Conklin carefully chooses contemporary issues which spark the students' interest, and he supports these issues with fact. The tutorial asks the student to estimate the effects of the particular issue. For example, in *PROFIS II*, the student is asked to "take a guess at the

number of murders per year per 100,000 residents of a large city like Boston." Conklin notes that the student generally overestimates the murder rates by a factor of 50 to 1, and the majority believe, contrary to fact, that the past was safer than the present.

Next, the tutorial introduces facts (data) and guides the student through an analysis of the facts. In each case, the appropriate methodology is also introduced and used in analysis. Finally, the student is given a homework assignment based on the facts given in the tutorial. This assignment requires the student to use the illustrated methodology to produce an answer.

Conklin notes that one important side effect of the use of the *PROFIS* modules has been that students use social facts rather than opinions to explain points made in essay examinations. Students also state that they find the tutorials nonthreatening and highly interesting.

One reviewer comments: "*Profis* is an excellent instructional tool... because it shows the student that the computer is a helpful but not infallible means by which data can be analyzed."

**T**he package from CONDUIT includes one copy of the *Instructor's Guide* and the software in machine-readable form (three interactive BASIC programs, ranging in size from 490 to 749 lines of code, written in CONDUIT Level 0 BASIC except for Level 1 string variable length).



a reviewed and tested package from CONDUIT  
Registry #SOC097/Sociology

# The Change Agent Game



Charles Weinberg  
Stanford University

*"Diffusion has long been cited as a social process ripe for simulation. Yet **Change Agent** is the first computer simulation of diffusion that is designed for teaching. It has been enthusiastically received by reviewers and is expected to serve as a prototype of instructional simulations in the social sciences. The pedagogical strength of the game is that it clearly demonstrates the major principles of innovation diffusion. The simulation effectively models innovation-diffusion and is a very interesting learning tool."*

Ronald Anderson  
CONDUIT Series Editor for Sociology

**T**he *Change Agent Game* is a computer-based simulation game designed to convey to students an understanding of change agent strategies in the diffusion of innovations. The game attempts to teach the basic functions of a change agent, and to facilitate the students' understanding of the theory of innovation diffusion and its application to developing societies.

A change agent is a professional who influences innovation decisions in a direction deemed desirable by the employing agency, such as an agricultural extension agency, the Peace Corps, a sales agency, schools, and companies. The change agent may fill any of seven roles in the change process: develop a need for change on the part of the clients; establish a change relationship with them; diagnose their problems; create intent to change in the clients; translate this intent into action; stabilize change and prevent discontinuances; and achieve a terminal relationship with the clients.

The game allows the student to assume the role of a change agent in a hypothetical community through the use of the computer program. Led by the program and the Student Guide, the student concentrates on two functions of a change agent: (1) developing a strategy to introduce change into a society; and (2) implementing that strategy in a simulated environment.

The hypothetical community (described in a written scenario in the Student Guide) is a rural village of 100 farm households divided into ten cliques of differing sizes. Each clique has an "opinion leader," an individual able to influence the other members of the clique.

Two types of decisions are available to the student in developing and implementing a strategy. Each decision costs the student a prespecified number of working days. (The number of days and percent adoption is actually set by the student while using the program, and thus can be set at the levels designated by the instructor.) The first type of decision

involves choosing what kind of information the student would like about the villagers' behavior. The kinds of information available to the student include: identifying an opinion leader, percentage of villagers reading newspapers, percentage of villagers listening to the radio, percentage of villagers who will attend a meeting, percentage of villagers who will attend a demonstration, percentage of villagers who can read and write, and the number of villagers who have adopted the innovation at that point during play of the game.

The second type of decision involves selecting the appropriate diffusion strategies to motivate villagers to adopt the innovation. The strategies available to the student include: talking to an opinion leader; using the newspaper or radio to create knowledge of the innovation; talking to a villager at random; giving a lecture at a public meeting; showing a film about the innovation at a public meeting; and conducting a demonstration of the innovation at an opinion leader's farm.

The game may be adapted to various social situations by writing a new scenario. This would only require describing the new scenario to the students, and possibly changing the scoring scheme to reflect the new scenario. The Instructor's Guide with the package includes complete details for any modifications desired.

**T**he package from CONDUIT includes one copy each of the *Student Guide* and *Instructor's Guide*, and the software in machine-readable form (one interactive BASIC program, 385 lines of code, written in CONDUIT Level 0 BASIC except for Level 1 sequential input/output files, file name as input, string variable length, MAT READ, MAT PRINT, MAT ZER, multiple assignment statement, computed GOSUB, and computed GOTO).

## Catalog of CONDUIT Reviewed and Tested Materials



The continuing activity of CONDUIT is to search for and select computer-based materials considered to be appropriate for use in undergraduate instruction. Our materials are reviewed by discipline experts and, when possible, by instructors who have used the materials in the classroom. Using the information collected during the review, Series Editors provide CONDUIT with an evaluation of the potential instructional value of the materials and their appropriateness for widespread distribution. This review process thus identifies materials meriting the continued investment of the resources needed to package the materials for transfer.

Packaging of materials by CONDUIT is aimed at providing instructors with the complete information and materials they will need to make effective use of the unit in the classroom. A three-year CONDUIT study revealed that the majority of existing materials could only be transferred from the originating site with nontrivial modifications to the programs, and a significant expenditure of time and personnel installing and documenting the programs. Packaging by CONDUIT increases the probability of successful transfer by eliminating many of these problems. The program code is modified to meet transferable standards thus eliminating the majority of machine-dependent features of the programs. The programs are thoroughly tested to verify the programs' performance both substantively and technically, and modified to enhance the clarity of input and output and ease of use. Complete supporting educational and technical documentation is provided to assist the instructor in implementing the programs on the computer and in the classroom.

The following brief abstracts are intended to provide the potential adopter with information about each package's instructional intent, mechanics of use in the classroom, and technical requirements for implementation. The elements of each package are listed in the abstract. Each package usually includes a student guide and an instructor guide, the programs in a transferable form, and detailed instructions to implementers for installing the software on your computer. The source code for each program has been modified to meet standards to ensure transferability. For FORTRAN, the adopted standard is ANSI FORTRAN (1966); for BASIC, standards are described in the *CONDUIT BASIC Guide* (see article that follows). CONDUIT also recently began distributing microcomputer versions of some of our packages for use on the PET, Apple, and TRS-80 microcomputers. (Packages with microcomputer versions are "starred" in the catalog under the appropriate discipline category.)

**If additional information on a particular package is needed in making a decision to adopt, abstracts including sample runs are available from CONDUIT for some of our packages. We also recommend you purchase a copy of each manual for the package for a complete picture of the content, intent, and presentation of the materials. Unfortunately, CONDUIT is unable to offer complimentary desk copies of our manuals. However, if you order a manual and later decide not to adopt the package, you may return the manual (within 30 days and in resaleable condition) and we will refund your money. Our return policy also applies to package purchases.**

A price list and forms for ordering packages are included at the end of this catalog.

*Note:* Each package description includes computer installation considerations for FORTRAN and/or standard BASIC versions. These restrictions do not apply to micro versions of a package. Following are the implied configurations for each of the micros:

**Apple:** Apple II, Applesoft in ROM, DOS, 48K

**PET:** Commodore PET2001, 8K

**TRS-80:** Radio Shack TRS-80, Level II BASIC, DOS, 32K

Any deviations from these micro configurations are noted after the versions specifications for a package. **Packages available in a microcomputer version are "starred".**



## Biology

### ★ COEXIST

**Registry #:** BIO118

**Topic:** population dynamics

**Suggested course:** General Biology

**Author:** P. J. Murphy, Chelsea Science Simulation Project, Chelsea College, London, 1975.

This unit simulates two biological situations. In the first, up to three populations are modeled to grow independently on identical, limited food resources. The student can then investigate the situation in which organisms compete only with members of their own species. In the second situation, two populations in competition with each other for the same limited resources are simulated. In each situation, the student controls a number of parameters (e.g., initial population and generation time) which influence the outcome of species competition.

**Package:** Six copies of Students' Notes (15 pages); one copy of Teachers' Guide (15 pages); software (interactive BASIC program, 315 lines of code) *Level 0*.

**Versions:** BASIC, Apple, PET, TRS-80

### ★ COMPLETE

**Registry #:** BIO182

**Topic:** plant competition

**Suggested course:** General Biology

**Author:** M. E. Leveridge, Chelsea Science Simulation Project, Chelsea College, London, 1975.

The study of interactions between flowering plants is an important aspect of ecology, and a considerable amount of experimental work has been carried out in recent years to investigate the factors that are involved. However, experimental work with real plants often takes a long time, and such projects are not always suitable for students. The computer simulation *Compete* enables students to plan and carry out an investigation without the long delay usually associated with growth experiments. The unit includes investigations with both real and simulated plants, and other relevant data in the form of graphs, tables, and descriptions.

The real experiments need to be set up well in advance of the time when the results are required, but the others can be carried out in one or two hours. The Students' Notes describe the investigations in a continuous sequence, but if time is short, some of them may be omitted. No prior knowledge about plant competition is assumed, but it is desirable that the students have a general background knowledge of the development of flowering plants, and of the resources which plants must obtain from their environment.

**Package:** Six copies of Students' Notes (15 pages); one copy of Teachers' Guide (11 pages); software (interactive BASIC program, 237 lines of code) *Level 0*.

**Versions:** BASIC, Apple, PET, TRS-80

### COMPUTERS IN THE BIOLOGY CURRICULUM

**Registry #:** BIO205

**Topics:** inheritance, predator-prey relationships, pond ecology, transpiration, counter-current systems, human energy expenditure, statistics for biologists

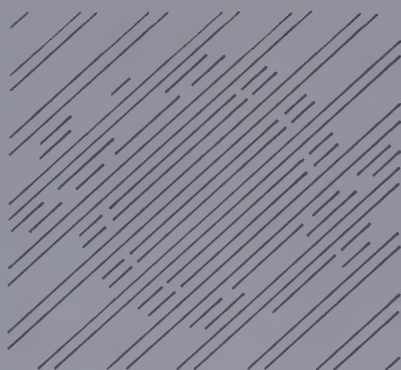
**Suggested course:** Introductory Biology

**Authors:** J. Denham, M. E. Leveridge, J. A. Tranter and J. Pluck, Schools Council Project, Chelsea College, London, 1978.

This package includes seven programs covering a wide range of topics in biology. The programs provide the facility for simulation gaming and model building, and computation and data retrieval. The intent of the materials is "to create activities for students which are primarily seen as problem solving" by leading the student through the work by a series of questions. The materials are "loosely" structured to ensure maximum flexibility for the instructor in planning individual units. The documentation is provided in loose leaf form so that the instructor may select and distribute specific desired pieces. The corresponding computer programs are:

*Inheritance* simulates inheritance of characters for three species of animals (fruit flies, mice, humans) and one species of plant (tomatoes). Multifactorial inheritance can be

## The CONDUIT BASIC Guide



The many dialects of the BASIC language available today on a broad range of computing equipment pose a barrier to the smooth and straightforward exchange of materials among dialects. Rather than defining a standard dialect, CONDUIT has prepared a guide for writing and transferring programs in any BASIC dialect based on a comparison of the features of over twenty dialects. From our study, we have adopted three levels of BASIC which will identify the features used in the standard materials we distribute (but not for microcomputer versions).

**Level 0** includes forms and statements that are part of almost every BASIC dialect, or for which an easy substitute is available, such as a different spelling of a key word (RESET instead of RESTORE). A program written in Level 0 code can often be successfully transferred to another computer with little or no modification.

**Level 1** includes all the features of Level 0 plus some extensions which are not found in all dialects. The extensions can usually be reprogrammed in Level 0 BASIC, or there are readily available replacements in the local dialect. For example, MAT statements are Level 1, but the same operations can be accomplished in Level 0 statements using defined arrays and indexing.

**Level 2** includes all the features of Levels 0 and 1 plus certain extensions that were judged to be both powerful and available in more than one dialect. These extensions may have no likely counterparts in some (lower-level) dialects, perhaps because they are machine-dependent. Even if a substitute is available, it is often in a much different form, at least in appearance. For example, some dialects have various machine-dependent functions that convert a string to a number and a character to its internal representation.

Each of the packages CONDUIT distributes in standard BASIC will be identified with the Level of the dialect. Any nonstandard features will be listed to aid the potential adopter in deciding if the package is adaptable to the local computer system. The *CONDUIT BASIC Guide* provides a detailed description of these Levels, and how to use the dialects surveyed. The *Guide* may be ordered using the Information Card attached.



simulated in the more complex version of the program.

*Predator-Prey Relationships* is a simple model to support the students' study of inter-species relationships in ecosystems.

*Pond Ecology* simulates a freshwater community consisting of three trophic levels: phytoplankton, herbivores and fish.

*Transpiration* simulates water loss by leaves. Included are a thorough description of a suggested preliminary laboratory experiment, and an explanation of the mathematical models used in the program.

*Countercurrent Systems* simulates two types of systems found in the bodies of animals: exchangers and multipliers.

*Human Energy Expenditure* contains data for men and women undertaking 72 different activities. The unit allows students to explore human energy requirements in relation to activity, sex and body mass.

*Statistics for Biology* computes simple statistics (mean, standard deviation, chi-square) for introductory level biology students.

**Package:** Student and Instructor documentation (combined) (162 pages); software (12 interactive BASIC programs ranging from 175 to 387 lines of code). *Level 0.*

**Version:** BASIC

#### ECOEXX I

**Registry #:** BIO087

**Topic:** prediction, analysis and simulation of ecological theory

**Suggested courses:** Introductory Ecology, Population Ecology, Computers in Biology

**Author:** Carl S. Hacker (The University of Texas School of Public Health), CONDUIT, Iowa City, Iowa, 1979.

*ECOEXX I* is a computer package for simulating the behavior of ecological systems. The package will complement many undergraduate and graduate ecology courses and will provide the student with a mechanism for studying ecological models in depth. The documentation for each program includes a brief description of the model simulated, the format for entering data, and a sample data set with output. Several exercises are suggested to direct the student in using the models. *ECOEXX I* includes three models which are described below.

*MRCAP* simulates a single-interval mark-recapture experiment. The student may specify the size of the population to be simulated, the size of the sample to be marked, the size of the second sample to be drawn, and the number of times the experiment is to be run. The student may also examine what effect a marked individual losing its mark has on the estimation of population size. The program will produce a table which includes the estimated size of the population as well as the mean and variance of the replicated experiments.

*JOLLY* simulates a multiple-interval mark-recapture experiment with up to 20 trapping intervals. The Jolly (1965) method is used to estimate the size of a simulated population at each interval. Birth and death rates and the logistic constants can be entered to control the growth of the populations during the simulation. The number of individuals collected at each sampling interval can be varied about a mean value by the pro-

gram. Data which have been derived from field studies can also be processed by the program.

*DISTR I* simulates a population of up to 3,000 sedentary individuals dispersed over a two-dimensional field. Several algorithms can be used to generate the coordinate pairs which specify each individual's position in the field. The student can create a physical model of the population using a line-printer plot. The dimensions of a rectangular quadrat can be specified, and the computer will sample the simulated population. The simulation generates a frequency table, and the number of quadrats expected in each class is calculated based upon the assumption that one of three distributions (uniform, exponential, normal) fits the observed distribution. The mean, variance, and the variance/mean ratio are also calculated from the observed results.

**Package:** Student Guide (70 pages); software (3 interactive or batch FORTRAN programs, maximum of 2,055 lines of code each).

**Version:** FORTRAN

#### ECOEXX II

**Registry #:** BIO296

**Topic:** prediction, analysis and simulation of ecological theory

**Suggested courses:** Introductory Ecology, Population Ecology, Computers in Biology

**Author:** Carl S. Hacker (The University of Texas School of Public Health), CONDUIT, Iowa City, Iowa, 1980.

This second release of the *ECOEXX* series includes three population growth models and a program to calculate cohort and current life tables.

*LESLIE* simulates the effect of age-specific survivorship and fertility schedules on the age distribution and density of a population. The student supplies an age-specific survivorship among the age classes. The program uses the mathematical techniques described by Leslie (1948) to project the population. Also, the density dependent constants described by Leslie (1959) can be entered.

*LIFTAB* calculates cohort and current life tables and a fertility table. The cohort table is generated from one of four age-specific vectors: age-specific survivorship, death, survival rate, and mortality rates. The current life table is generated using census data from a population which gives the size and number of deaths in each age class. A fertility table is calculated from observations on age-specific survivorship and fertility.

*GRODET* simulates the growth of a population using either of two well-known population models which include the ex-

ponential growth law  $\frac{dN}{dt} = rN$  and the

logistic growth model  $\frac{dN}{dt} = rN(1-N/K)$ .

The student enters  $r$ ,  $N_0$ , and  $K$ , and the program calculates the density of the population at successive intervals of time using a fourth order Runge-Kutta algorithm.

*GROSTO* simulates the growth of a population using a stochastic form of the two growth models in *GRODET*. The above equations are rearranged to give the ex-

ponential model  $\frac{dN}{dt} = (a_1 - a_2)N$  where  $a_1$  is

the birth rate,  $a_2$  is the death rate, and  $a_1 - a_2$

equals  $r$ . The logistic model  $\frac{dN}{dt} = (a_1 - a_2)N$

$(b_1 + b_2)N^2$  where  $(a_1 - a_2) = r$  is rearranged to

give  $\frac{a_1 - a_2}{b_1 + b_2} = K$ . The student enters

$a_1$ ,  $a_2$ ,  $b_1$ , and  $b_2$ , and the program calculates the density of the population at successive intervals.

**Package:** Student Guide (30 pages); software (4 interactive or batch FORTRAN programs, maximum of 1,000 lines of code each).

**Version:** FORTRAN

### ★ ECOLOGICAL MODELING

**Registry #:** BIO083

**Topics:** ecology, ecosystem, population growth

**Suggested courses:** Introductory Ecology, General Biology

**Authors:** Wm. Reinert, Wm. Glanz, & S. Cornish (Dartmouth College), CONDUIT, Iowa City, Iowa, 1973.

This package introduces students to some techniques for modeling ecological systems and processes on the computer. By controlling certain parameters, such as initial population size, growth rate, time length of the simulation, and others, the student experimentally tests hypotheses and predicts results about ecosystems. The programs and the concepts are presented in the student manual in a sequence of increasing complexity. Population growth is first considered as unlimited growth of a single species. Two programs trace exponential growth of a population, but differ in their method of computation: *Epop* uses an analytical solution for the differential equations; *Epop* uses difference equations for incrementing growth.

In succeeding programs, additional environmental factors which the student may manipulate are introduced: environmental carrying capacity, random environmental factors, and competitive interaction between species. Each of these concepts builds toward the last program, a simulation of the growth and interactions of trophic levels within an arctic tundra ecosystem. This last program provides the student with the facility to experiment with modeling techniques in simulating ecosystems.

**Package:** Three copies of Student Manual (76 pages); software (8 interactive BASIC programs, ranging in size from 46 to 253 lines of code). *Level 0.*

**Versions:** BASIC, Apple, PET, TRS-80



## ★ENZKIN

**Registry #:** BIO181

**Topic:** enzyme kinetics

**Suggested course:** Biochemistry

**Author:** M. T. Heydeman, Chelsea Science Simulation Project, Chelsea College, London, 1976.

A piece of experimental research requires at least three kinds of work: planning of experiments, performance of the experiments, and interpretation of the results. Only the middle stage involves laboratory work, and it is on this stage that traditional biochemical teaching concentrates. Of course, performing experiments is important, but there is a danger that planning and interpretation may be neglected as time and resources do not permit enough laboratory work to support them.

Interpretation can be practiced with data and instructions from books, but practice in planning cannot be undertaken without the performance of many experiments. This unit permits the student to obtain realistic results using a computer program to simulate enzyme-catalyzed reactions. *Enzkin* allows many cycles of planning, experimentation, and interpretation over a short time.

The introduction to the Students' Notes describes some of the features of enzyme-catalyzed reactions. In later sections, students are asked to plot progress curves and calculate initial velocities of reactions. Six enzymes with different properties are simulated in the computer program so that each student, or group of students, can obtain different results.

**Package:** Six copies of Students' Notes (15 pages); one copy of Teachers' Guide (15 pages); software (interactive BASIC program, 292 lines of code). *Level 0*.

**Versions:** BASIC, Apple, PET, TRS-80

## ★EVOLUT

**Registry #:** BIO082

**Topics:** natural selection, genetics

**Suggested course:** General Biology

**Author:** S. McCormick, Chelsea Science Simulation Project, Chelsea College, London, 1975.

*Evolut* is an introductory unit in evolution and population genetics, intended to teach: (1) mechanisms generating variation and the selective process leading to adaptations; (2) adaptation to environmental conditions in relation to survival value; (3) manipulation of models of selection acting on populations; and (4) investigation of the power of selection in producing certain frequencies of alleles in a given environment and relation of adaptation to survival. An elementary knowledge of genetics is required for effective student use. The computer program allows the student to test the hypothesis that inherited variations showing a small positive survival value are sufficient for micro-evolution. Students select various parameters in the model, including zygote type, percent of selection, size of population, initial percent of green alleles, and number of generations, and they observe the simulated process of natural selection and evolution.

**Package:** Six copies of Students' Notes (19 pages); one copy of Teachers' Guide (11 pages); software (interactive BASIC program, 243 lines of code). *Level 0*.

**Versions:** BASIC, Apple, PET, TRS-80

## ★LINKOVER

**Registry #:** BIO122

**Topic:** genetic mapping

**Suggested courses:** General Biology, Genetics

**Author:** P. J. Murphy, Chelsea Science Simulation Project, Chelsea College, London, 1975.

This unit is designed to provide students with the opportunity to plan and execute genetic mapping experiments in order to reinforce learning of the concepts of linkage and crossing-over. The Teachers' Guide includes instructions to modify the model to simulate more closely the natural situation by: altering the number of offspring; randomizing the number of offspring; altering a gene symbol; altering the locus of a gene; adding and removing genes from the linkage group.

**Package:** Six copies of Students' Notes (11 pages); one copy of Teachers' Guide (15 pages); software (interactive BASIC program, 422 lines of code). *Level 0*.

**Versions:** BASIC, Apple, PET, TRS-80

## TRIBBLES

**Registry #:** BIO248

**Topic:** scientific method

**Suggested Course:** Introductory Biology

**Authors:** R. Von Blum and T.M. Hursh, Project SABLE, Lawrence Hall of Science, University of California, Berkeley, 1976.

This introductory unit on the scientific method consists of a written tutorial (in the form of a student guide) and a computer simulation. The tutorial presents students with a problem, and guides them to its solution. The computer simulation simply provides the data for making observations and for forming tentative explanations and testing predictions. To eliminate the variable of background knowledge, the problem takes place on an alien planet, and the students observe alien organisms called tribbles.

Students are guided in making detailed and systematic observations of tribbles on the computer terminal to determine whether shifts in number and position are random or follow set patterns. Next, the tutorial introduces the idea of an explanatory system. This involves making explicit the set of assumptions that influence the way the phenomenon is observed. In this case, tribbles are assumed to be like earthly organisms, but since the "organisms" are being observed from a distance, all one can do is to concentrate on certain observable aspects of tribble population.

Students are then guided in the construction of a tentative explanation for tribble growth. Their first, "simple" explanation, however, quickly proves inadequate, and they must revise their explanation. The tutorial suggests employing another common scientific procedure — breaking the problem down into its parts and seeing if progress can be made on one aspect of the problem at a time. Students are led to discover explanations

for birth and death, first separately and then as a total prediction for the observed complex behavior of the tribble population. The student then goes on to test predictions made from this explanation against data provided by the computer simulation. Finally, the tutorial summarizes the entire procedure that he has used, and emphasizes the relationship between biological "facts" and scientific explanation.

**Package:** Five Student Tutorials (30 pages); software (one interactive BASIC program, 250 lines of code). *Level 0 BASIC except for string variables up to 70 characters long*.

**Version:** BASIC

## ENZYME SEQUEN

**Registry #:** BIO293

**Topic:** enzyme-substrate interactions, amino acid sequence of proteins

**Suggested courses:** Introductory Biology, Cell Biology, Introductory Biochemistry

**Authors:** R. Von Blum, T.M. Hursh, T. Lempert, and D.C. Gillis, Project SABLE, Lawrence Hall of Science, University of California, Berkeley, 1976.

The two modules in this package provide instructional supplementation in two key areas in biology — enzyme-substrate interactions and protein structure. Via computer simulation students can experience "practical" or direct analysis with these theories and produce results which are virtually impossible to reproduce in the traditional undergraduate laboratory. Each unit consists of a written self-instructional booklet called a tutorial, and a computer simulation to provide data for the students' analysis and prediction. The tutorials provide immediate feedback to the student through frequent questioning with answers supplied in the back of the booklet, helping to assure understanding of the materials presented. Because of the shortened time required to produce data via the computer simulation, one experiment can be run repeatedly and many alternative explanations can be tested.

*ENZYME* simulates enzyme-substrate interactions. The student may experiment with the effects of different substrate concentrations, enzyme concentrations, enzyme affinities, and pH's on reaction rate. *ENZYME* models the salivary amylase-starch reaction using the Michaelis-Menton equation. The student may choose any of three experiments: percent velocity vs. substrate concentration; percent velocity vs. enzyme concentration; or maximum velocity vs. pH. For each experiment the results generated by the computer program are plotted.

*SEQUEN* simulates the biochemical process to determine the amino acid sequence of a protein. The student first specifies the length of the protein, from 1 to 50, and then any one of five substances for the computer program to treat the protein: hydrochloric acid, phenylisothiocyanate, carboxypeptidase A and B, cyanogen bromide, or trypsin. The student is given three chances to identify the original protein.



**Package:** Five copies of the Student Guide (10 pages); software (two interactive BASIC programs, 400 and 300 lines of code). *ENZYME* is written in Level 0 BASIC, *SEQUEN* in Level 0 BASIC with the exception of string variables up to 200 characters long. **Version:** BASIC

## Chemistry

### ★CHEMISTRY LABORATORY SIMULATIONS

**Registry #:** CHM254

**Topics:** kinetics, Bohr atom, oxidation-reduction, titration

**Suggested course:** Introductory Chemistry

**Authors:** Wm. M. Butler and Henry C. Griffin (University of Michigan), CONDUIT, 1979.

This package of four programs for the PET 2001 treats four basic topics in introductory chemistry. The programs provide valuable supplementary treatment of topics that often cause difficulty for the introductory chemistry student. Use of these programs will prepare students for the actual experiments in the lab and extend their knowledge in these areas of chemistry. *Titration*, a simulation of an acid-base neutralization, allows students to investigate some of the general problems encountered in a typical strong acid strong base titration. The student's goal is to successfully determine the concentration of several unknown acids by the process of titration. *Kinetics*, a simulation of a first order chemical reaction, allows students to calibrate a typical and analytical instrument for the monitoring of a chemical reaction and then to study the factors that affect the rate of the reaction. The student's goal is to change the rate of a chemical reaction by adjusting the experimental conditions (temperature, pH) until an accurate rate constant can be determined. *Redox*, a simulation of oxidation-reduction reactions, is intended to acquaint students with the type of experimental evidence and analysis needed to rank a group of reagents (metals) in order of their power as reducing agents. *Bohr Atom* is a simulation of the Bohr model of one-electron hydrogen-like atoms. The program is intended to help students better understand the nature of electrostatic attraction forces in an atom by investigation of the behavior of an electron about a positively charged nucleus (as described by the Bohr model). All of these programs make creative and effective use of the graphics and animation capabilities of the PET.

**Package:** User's Manual (20 pages); software (4 interactive BASIC programs for the PET 2001 microcomputer).

**Version:** PET

### FRSTLW

**Registry #:** CHM081

**Topic:** thermodynamics

**Suggested courses:** Introductory Chemistry, Introductory Physics, and Physical Chemistry

**Author:** Wallace H. Baird. Revised by Joseph Denk, CONDUIT, Iowa City, Iowa 1974. BASIC version by Eric Lane, University of Tennessee at Chattanooga.

This tutorial program is designed for student exploration of the relationship of an ideal gas to the First Law of Thermodynamics. Students can use any combination of adiabatic, isobaric, isochoric, or isothermal steps to define a path for an ideal gas to reach a prespecified state. One of these four steps is selected by the student, and then the initial and final conditions of the gas, the molar heat capacity of the gas at constant pressure, the number of moles of a gas, and one end-of-step condition are specified. By successive selection of steps, a final state is reached.

**Package:** Manual (23 pages); software (interactive FORTRAN (1,021 lines of code) or BASIC). The BASIC version of the package includes two versions of the program: Version 1 recognizes lowercase alphabetic input (632 lines of code); Version 2 only allows uppercase input (629 lines of code). *Level 0 except for Level 1 computed GOTO and string variable length.*

**Versions:** BASIC, FORTRAN

### ★HABER

**Registry #:** CHM199

**Topics:** ammonia synthesis, Haber process

**Suggested course:** Introductory Chemistry

**Authors:** R. Edens and K. Shaw, Chelsea Science Simulation Project, Chelsea College, London, 1978.

The production of ammonia by the Haber process is an important process in chemical industry, and yet one not easily performed by students in conventional laboratory investigations. The Haber simulation provides students with the opportunity to study the Haber process and how the various conditions (temperature, pressure, catalyst and reactant concentration ratios) influence the course of the reaction (i.e., the time required to reach equilibrium and the equilibrium yield of ammonia). In Investigation 1, Properties of a System at Equilibrium, the student specifies the constant molar ratio, the initial temperature, the increase in temperature, and the constant pressure, and selects to vary the pressure, temperature or initial hydrogen-to-nitrogen ratio. The program then calculates and displays the percentage yield of ammonia against the varying parameter for the conditions chosen by the student.

In Investigation 2, The Haber Process, the student specifies which catalyst to use (none, osmium, tungsten, molybdenum, iron or manganese dioxide), and then chooses a temperature and pressure for the investigation. At time intervals set by the student, the simulation calculates the amount of ammonia formed, expressed as a percentage of ammonia in the equilibrium mixture.

Before using this unit, students should be introduced to the concepts of the equilibrium law, Le Chatelier's Principle of Equilibrium,

the rate law from kinetics, the ammonia synthesis mechanism, the effect of temperature on the rate constant, and the effects of catalysts.

**Package:** Six copies of Students' Notes (11 pages); one copy of Teachers' Guide (15 pages); software (interactive BASIC program, 308 lines of code). *Level 0.*

**Versions:** BASIC, Apple, PET, TRS-80

### IDGAME

**Registry #:** CHM011

**Topic:** organic qualitative analysis

**Suggested course:** Organic Chemistry

**Authors:** Frederick Homack, Nancy Hetzel, and Molly Hepler (N. C. Educational Computing Service), CONDUIT, Iowa City, Iowa, 1975.

*Idgame* is a qualitative organic identification game which uses a data base of 20 organic compounds to teach strategies for analyzing organic compounds. The purposes of *Idgame* include: (1) teaching qualitative analysis in the "dry lab" setting; (2) reducing the number of unknowns to be analyzed in a regular lab; (3) exposing the student to optimizing techniques through a gaming situation; and (4) establishing the concept of industrial costs related to chemical analysis. To use this program effectively, students should have a background similar to that required for beginning laboratory classes, but no computer background is necessary.

The instructor selects one or more unknowns from the data base and assigns them to one or more students who then pursue the identification of the unknown by making computer runs to get simulated laboratory test results. The compound name itself is not available as output from the game; only the analytical results of the 41 tests can be requested.

**Package:** Instructor's Guide (including Student Guide, 52 pages); software (interactive or batch FORTRAN program, 1,544 lines of code and 3 data files, 220, 249, and 65 lines of code).

**Version:** FORTRAN

### KSIMS

**Registry #:** CHM088

**Topics:** chemical kinetics, order and rate constant

**Suggested courses:** Physical Chemistry, Introductory Chemistry

**Authors:** Dwight Tardy, H. Warren Smith, Joseph R. Denk, and Nancy Hetzel, CONDUIT, 1978

The objectives of *Ksims* are to introduce the element of experimental design into the undergraduate study of chemical kinetics, and to allow students to interpret raw kinetic data from a simulated experiment so that the balanced chemical equation, rate law, rate constant, activation energy and pre-exponential factor can be obtained. The student sets the values of temperature, initial concentration of reactants, and which substances are to be analyzed at predetermined times. The student also has the option of introducing experimental errors associated with each of the variables so that a more



"realistic" experiment is simulated. The student can request a concentration-time table, a rate-time table, and plots of function of the concentration vs. time as output. The program also performs a least squares analysis, and the slope and intercept and their standard deviations are calculated so the student can assess the "goodness" of the plotted concentration functions. From this output, the student can deduce the balanced chemical equation, the rate law, and the rate constant. By simulating experiments at a variety of temperatures, the student can calculate the Arrhenius parameters. By using the (optional) precisions options, the student can study the effect of experimental variables on the accuracy with which the rate parameters can be obtained.

**Package:** Five copies of Student Manual (15 pages); Instructor's Guide (17 pages); software (interactive FORTRAN program, 1,771 lines of code (includes about 200 comment lines)).

#### NEUTRON ACTIVATION ANALYSIS

**Registry #:** CHM119

**Topic:** neutron activation, half-life, radioisotopes

**Suggested courses:** Physical Chemistry, General Chemistry

**Author:** Ted Hopkins (University of Oregon), CONDUIT, Iowa City, Iowa, 1976.

This program was inspired by a program *Radio* included in the text *Numerical Methods in Chemistry*, K. Jeffrey Johnson, University of Pittsburgh, and an experiment conducted at the Radiation Center, Oregon State University. In this experiment, a short length of wire (an alloy of aluminum and indium) is activated by neutron bombardment in the TRIGA reactor. The radioisotopes which are produced,  $^{28}_{13}\text{Al}$  and  $^{110}_{49}\text{In}$ , each decay with different half-lives. The total decay curves for sample wires of different compositions are simulated by the program. The half-lives and initial activities of the various samples can be determined by analyzing the decay curves. The student chooses a sample number, how soon to begin counting the sample after ejection from the reactor, and details about the counting of the sample (e.g., counting times, intervals, duration). The total count rate calculated by the program is given an appropriate scatter through the use of a random number subroutine. The data are then presented in tabular form, followed by a log plot of activity versus time for the same data. The log plot enables the student to immediately decide whether proper decisions were made with regard to the counting parameters for the sample. The experiment can then be repeated if changes are needed.

The material is suitable for students in beginning courses in physical chemistry or nuclear chemistry. First year general chemistry students should have studied course work related to radioactivity before using the program. The program should be particularly useful as supplemental work for laboratory courses in physical, nuclear and general chemistry.

**Package:** Student Manual (21 pages); Teacher's Guide (32 pages); software (interactive FORTRAN program, 872 lines of code).

**Version:** FORTRAN

#### NMR

**Registry #:** CHM226

**Topic:** nuclear magnetic resonance spectra

**Suggested courses:** Physical Chemistry,

Physical Organic, Interpretation of Spectra

**Authors:** P.B. Ayscough, et.al.

(CALCHEM, United Kingdom), CONDUIT, Iowa City, Iowa, 1979.

The materials in this package provide students with the opportunity to practice interpreting first order spectra. As a result of using the materials, the student should be able to interpret simple NMR spectra using a systematic approach. The materials assume some knowledge of the theory of NMR spectroscopy and therefore should be used following a first course in NMR. No experimental work is necessary, although students may be required to obtain their own spectra on occasion. The student may select any spectrum from a prescribed set, and the computer program will guide him through the analysis. Normally, the instructor selects a set of compounds and gives the student prerecorded spectra. The student is then led to deduce the structure in a logical manner, starting with multiplicities and intensities and then taking chemical shifts into account. The student may leave the analysis scheme at any step in order to identify the compound. If the student chooses this course and makes an incorrect deduction, he is returned to the program at the point where he left off.

The instructor may add new sets of spectral data by using a utility program included with the package.

The package includes an Instructor's Manual which entails: instructional information about the package and how it fits into the course; essential background theory, experimental details, and treatment of results for the instructor; description of the computer program and sample sessions; general technical description of the programs; and samples of the essential ancillary material that should be given to students, including graphs, spectra, and equations. No specific student guide is provided since the authors felt each instructor would prefer to prepare his own worksheets tailored to the needs of the particular course.

**Package:** Instructor Manual (including student information) (50 pages); software (2 FORTRAN programs (maximum size 2,677 lines of code) and data file (189 card image records)).

**Version:** FORTRAN

#### ★ RKINET

**Registry #:** CHM160

**Topics:** chemical reaction kinetics, first and second order reactions, rate constants, concentrations

**Suggested course:** General Chemistry

**Author:** A. W. B. Aylmer-Kelly, Chelsea Science Simulation Project, Chelsea College, London, 1975.

This simulation is intended to extend students' laboratory experience and understanding of reaction kinetics by enabling them to carry out a wider range of investigations. It will also help students understand the relationship between a mathematical model and reality. The simulation model, which is based on data from real experiments, will broaden students' knowledge of first- and second-order reactions, rate constants, concentrations, and the effect of variation of temperature on reaction rate.

**Package:** Six copies of Students' Notes (10 pages); one copy of Teachers' Guide (10 pages); software (interactive BASIC program, 245 lines of code). *Level 0.*

**Versions:** BASIC, Apple, PET, TRS-80

#### QUANTUM CHEMISTRY

**Registry #:** CHM138

**Topics:** quantum mechanics, atomic, molecular, and hybrid orbitals, Huckel theory, particle in a box, electron density contours, radial distribution functions

**Suggested courses:** General Chemistry, Physical Chemistry, Advanced Inorganic Chemistry, Organic Chemistry

**Authors:** K. Jeffrey Johnson and Warren T. Zemke, CONDUIT, Iowa City, Iowa, 1978.

Students of chemistry will find this package helpful in their study of atomic and molecular structure, and chemical bonding. Each of the four computer programs in the package assists students in their understanding of wave functions or orbitals which describe the location of an electron in an atom or molecule, and energy level patterns necessary in interpreting atomic and molecular spectroscopy.

In general, no programming knowledge is required on the part of the student. Instead, the student typically interacts with each program by supplying a few parameters in response to questions. The programs then carry out the appropriate quantum mechanical calculations and provide the student with corresponding graphical and/or numerical results. The four programs included in the package are:

*Contour* calculates and plots electron density contours for select atomic, hybrid, and molecular orbitals from Slater-type wave functions.

*Radial* calculates and plots normalized radial distribution functions for the 1s, 2p, 2s, 3p, and 3d hydrogen-like atomic orbitals.



Box calculates the energy levels for a particle of mass,  $m$ , confined to a one-dimensional finite potential well of length  $a$ .

Hmo calculates the molecular energy levels, LCAO-MO wave functions, electron charge densities, bond orders, free valencies, and the total  $\pi$  electronic energy according to simple Huckel theory.

**Package:** User's Guide (33 pages); Instructor's Notes (5 pages); software (four interactive FORTRAN programs ranging from 570 to 1,299 lines of code or four interactive BASIC programs ranging from 141 to 729 lines of code). *Level 0 except for Level 1 string variable length, program size for some programs, and MAT INPUT.*

**Versions:** BASIC, FORTRAN

#### TITRATION AND RELATED PHENOMENA INVOLVING IONIC EQUILIBRIA

**Registry #:** CHM102

**Topics:** titration, ionic equilibria

**Suggested courses:** General Chemistry, Analytical Chemistry

**Authors:** R. W. Collins, K. J. Johnson, and C. T. Furse, CONDUIT, Iowa City, Iowa, 1977.

This package covers a variety of topics within the general area of titration phenomena and ionic equilibria, including: aqueous equilibria for mono-, di- and triprotic acids; metal ion-EDTA titrations; metal ion complexation; the potential of metal/metal ion electrodes versus pH in aqueous ammonia; solubility as a function of pH; processing titration data by the derivative method; and simulating a variety of titration curves. The package includes a User's Guide, Instructor's Notes, and eleven programs available in both BASIC and FORTRAN. The majority of the programs produce typical laboratory data through simulation of a chemical process. Three of the programs produce student exercises, complete with answer keys for the instructor. These problem sets can be used as lecture assignments, or as prelaboratory experience for the students. Another program allows students to process their own pH or potentiometric titration data. The instructor's use of the package is aided by a "usage flowchart" which helps the instructor decide which program(s) suit the needs of the course. By answering questions about the concepts presented in the course, the instructor "steps through" the sequence of programs, and how these programs may supplement classroom and textbook instruction. A thorough presentation of the concept in lecture or through a standard textbook is still necessary: the programs require supporting instruction.

**Package:** Manual (62 pages); software (12 interactive FORTRAN programs ranging from 506 to 848 lines of code or 12 interactive BASIC programs ranging from 96 to 387 lines of code.) *Level 0 except for Level 1 MAT INPUT, READ, and assignment.*

**Versions:** BASIC, FORTRAN

#### X-RAY

**Registry #:** CHM252

**Topic:** X-ray crystallography

**Suggested course:** Physical Chemistry, Diffraction Analysis

**Authors:** N.A. Bailey, et.al. (CALCHEM Project, United Kingdom), CONDUIT, Iowa City, Iowa, 1979.

This package was developed to allow students access to those techniques commonly used for crystal structure analysis. It is intended to be used in conjunction with a formal lecture course on x-ray crystallography or the study of a standard text, and is thus suitable both for undergraduate and graduate teaching. The materials do not teach basic concepts or theory; they provide data and computational facilities which allow each stage of the structure analysis to be carried out separately. The student is expected to spend only short periods of time at a computer terminal: time-consuming parts of the structure analysis, such as Patterson solution or drawing Fourier maps, are to be done away from the terminal. Eight calculations are available: Patterson function, superposition function, structure factor calculations, least-squares calculations, observed and difference Fourier maps, direct methods (calculation of  $|E|$  values), calculation of sign fixed map, and geometry calculations. Five sets of spectral data are included in the package. New data sets can be easily added by the instructor using an interactive program also supplied with the package. The Instructor's Manual gives details of the information needed for a new data set, as well as student information and a complete technical description of the program. No specific student guide is provided since the authors felt each instructor would prefer to prepare his own worksheets tailored to the needs of the particular course.

**Package:** Instructor's Guide (including student and technical information) (47 pages); software (2 FORTRAN programs and 22 subroutines (1,900 lines of code) and one data file (170 card image records). Interactive input/output required and, optionally, line printer output.)

**Version:** FORTRAN

## Economics

#### COMPUTER SIMULATION POLICY GAMES IN MACROECONOMICS

**Registry #:** ECN043

**Topic:** macroeconomic policy

**Suggested courses:** Intermediate Macroeconomics, Principles of Economics

**Author:** Richard Attiyeh, CONDUIT, Iowa City, Iowa, 1976.

These six macroeconomics policy games attempt to convey to the student an understanding of the aggregate behavior of the economy by casting him in the role of economist and policy-maker for a simulated, real-world economy. These games can be used with introductory, intermediate, or advanced students, although the complicated models are more suited to students who

have nearly completed a semester of introductory macroeconomics or are taking an intermediate course. Each game uses a time series model or "history" of the economy to inform the student of past model behavior. In choosing values for the policy variables, the student learns the value of economic analysis; in trying to identify and understand the structure of the model, the student applies economic theory; and in playing the game, the student appreciates the usefulness of economic events.

**Package:** Student Manual (28 pages); Instructor's Manual (159 pages); software (5 interactive BASIC programs, ranging in size from 139 to 336 lines of code, and one interactive FORTRAN program, 665 lines of code). *Level 0 except Level 1 sequential file read and write.*

**Versions:** BASIC (plus one FORTRAN program)

#### MODSIM

**Registry #:** ECN239

**Topics:** econometric models, forecasting

**Suggested courses:** Macroeconomic Forecasting, Intermediate Macroeconomics, Business Cycles, Monetary and Fiscal Policy

**Author:** Carl Van Duyn (Williams College, Massachusetts), CONDUIT, Iowa City, Iowa, 1980.

MODSIM is a sophisticated but easy to use program for simulating or solving quarterly econometric models of the U.S. economy. The program can perform many of the computations normally employed in applied macroeconomics to simulate and evaluate econometric models, including historical simulations, forecasts, and analyses of alternative government stabilization policies.

The MODSIM package was designed to expose students to some important techniques of applied macroeconomics and econometrics, to require them to take an active part in their economics education, and to provide a more concrete alternative to the abstract analytical models that form the core of most economics courses. MODSIM is intended for more advanced undergraduate macroeconomics and econometrics courses and for forecasting courses at graduate schools of business, courses where students typically have had some exposure to quantitative methods. MODSIM can also be used for student and faculty research in applied macroeconomics.

MODSIM contains three econometric models of the U.S. economy that differ substantially in size and scope. The first model is a small Keynesian model containing ten behavioral equations developed by Robert S. Pindyck and Daniel L. Rubinfeld.



## CONDUIT Author's Guide

If you want to prepare materials for distribution by CONDUIT or if you want to produce effective instructional materials, the *Author's Guide* is for you. This guide covers the areas of design, development, style, packaging, and reviewing. Reviewers tell us that the *Guide* fills a need for a practical how-to-do-it text based upon experience and tested theory.

CONDUIT can help authors of computer-based materials in several other ways. We can offer *development advice* to help create complete, high quality, transferable packages. Our initial screening and *peer review* will also provide you with an assessment of your work and suggestions for improvement. We will work with you to *package* your materials to CONDUIT standards, including editing and printing written materials, and preparing the computer elements for transfer. We will *distribute* and *maintain* your materials, a task that requires our experience with sending out computer-based materials to a variety of schools with differing computer systems. *Author recognition* follows from having materials reviewed and tested by CONDUIT. Our reputation for quality, and our peer review, can provide evidence of the merit of your work.

To have your materials considered for publication or distribution by CONDUIT, send us all items that would help, but not overwhelm, a reviewer. This may include manuals, sample sessions, a program listing, and any evaluative data collected. If you are just starting development, get a copy of the *Author's Guide*. It will prevent problems later in the process. The *Guide* may be ordered using the CONDUIT Information Card attached.

Although substantially smaller, this model is akin to the large econometric models of the U.S. economy most frequently used by the economics profession. The second model is the April 1979 version of the well-known monetarist model developed by the Federal Reserve Bank of St. Louis. The third model is a very small four equation ISLM model similar to one in the first edition of Pindyck and Rubinfeld's text (1976). It is too small to explain the behavior of the economy very well, but it can be used effectively in econometrics courses for studying the problems of estimating simultaneous equation models.

**Package:** Includes five copies of User Manual (90 pages); Instructor's Guide (80 pages); and software (one batch FORTRAN program consisting of 4,500 source lines (mainline and 40 subprograms), three model data files (about 325 punched card images each), and one sample input file of about 525 punched-card images). Program uses sequential, punched card image data files: one for temporary storage and one for each model (up to 6 models).

**Version:** FORTRAN

## Education

### CRITICAL INCIDENTS IN EDUCATION

**Registry #:** EDU154

**Topic:** classroom situations

**Suggested courses:** Methods Courses, Science Education, Computers in Education

**Author:** Vincent N. Lunetta (The University of Iowa), CONDUIT, Iowa City, Iowa, 1975.

This package provides twenty-two simulations of classroom situations that allow prospective teachers to examine human interactions in schools. Each simulation begins with a description of a realistic incident confronting a teacher. The prospective teacher is then given a number of possible responses, and must select one which fits his or her teaching style. Responses are generally classified as extreme authority, ignore, moderate authority, and shared authority. During the simulation, feedback is provided in the form of reactions from principals, students, parents, and other teachers in much the same way as in a real school setting. Critical commentary and suggestions are presented to the student at the end of the simulation.

These simulations can be used in a variety of ways in support of teacher education. They are an excellent resource to broaden the base of experience for preservice and in-service teachers, and to focus on issues facing teachers, administrators, and students today.

**Package:** Instructor's Guide (57 pages); five copies of Student's Guide (10 pages); software (26 BASIC programs ranging in size from 247 to 697 lines of code). *Level 0 except Level 1 MAT ZER and program size.*

**Version:** BASIC

### GHETTO

**Registry #:** EDU034

**Topics:** ghetto life, disadvantaged children

**Suggested courses:** Computers in Education, General Methodology Courses, Teaching the Disadvantaged.

**Author:** Judy Edwards, CONDUIT, Iowa City, Iowa, 1977.

The *Ghetto* simulation is designed to sensitize its players to the emotional, physical, and social world the disadvantaged inhabit. Players assume the role of one or more of ten "ghetto" residents, and experience vicariously the economic pressures that drive people into crime, welfare, and community action. The players attempt to improve their lives by investing hours in various activities and collecting as many reward points as possible. Each ghetto resident is described by sex, age, marital status, level of education, number of children, and number of hours to invest. Investments may be made in school, work, hustling (illegal activity), relaxation, and welfare. As capricious events occur which negate the player's investments, and reduce or eliminate reward points, the player experiences frustration akin to the frustrations of the disadvantaged.

**Package:** Instructor's Guide (20 pages); software (3 interactive BASIC programs, ranging from 171 to 837 lines of code). *Level 0 except for Level 1 computed GOTO, CHAIN, string variable length, multiple assignment statement; program size, and ASCII characters for CR and LF in input data file; and Level 2 direct access file input/output. This package is nontrivial to implement.*

**Version:** BASIC



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## Geography

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### OPTIMAL LOCATION OF FACILITIES

**Registry #:** GEO091

**Topic:** locational analysis

**Suggested courses:** Introductory Geography, Economic Geography, Transportation, Industrial Location, Private and Public Facility Siting, Locational Analysis

**Author:** Gerard Rushton, COMPRESS, Inc., Wentworth, New Hampshire, 1974.

This package, suited for either introductory or advanced geography, focuses on locational analysis using a prescriptively oriented approach rather than traditional inductive statistical analysis. The text is organized into substantive discussion, handworked examples, student exercises, and computerized algorithms. The chapters of the text deal with general issues and concepts in locational analysis, single-source locational problems, multi-facility location in continuous space, and multi-facility location in a network.

Students are introduced to increasingly difficult topics in location theory as a prescriptive science, and develop skills in thinking through and performing locational analysis. Small problems and hand calculations are stressed so that the complexity of location problems are realized before the student uses the computer programs.

**Package:** Student Manual (160 pages); software (14 batch FORTRAN programs, ranging in size from 194 to 1,654 lines of code).

**Version:** FORTRAN

THE SPATIAL MARKETING SIMULATION (GEO157) IS NO LONGER BEING DISTRIBUTED BY CONDUIT DUE TO INSURMOUNTABLE TRANSFER PROBLEMS

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## Humanities

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### DIALOGUE

**Registry #:** HUM143

**Topics:** grammar, basic writing skills, sentence structure

**Suggested courses:** Expository English, Communications

**Author:** Susan W. Wittig (Project CBE, The University of Texas at Austin), CONDUIT, 1974.

These computer-assisted tutorials are designed to supplement and support classroom work in sentence syntax, and to provide a quick review of basic syntactical problems. They may also be used independently by students working outside of a course framework to increase their understanding of syntax and to help them improve their compositional skills. These modules are written for nonremedial students and for students without severe dialect problems; they do not, for example, teach verb tense patterns. They stress the sentence patterns of written English, because many students are relatively unfamiliar with those patterns, although they may be orally competent.

Each of the modules is constructed according to a similar pattern: each contains a series of sections which include instructional exercises and test questions selected randomly from a large pool of test questions.

Each of the seven modules consists of four to nine sections. The modules require about 45 minutes each to complete for the average student. The topics covered in each module are: basic sentence patterns; nouns, verbal nouns, nominal style, sentence maturity; specification with adjectives; specification with adverbs; coordination; appositives; and adjective clauses.

The author strongly recommends that any instructor or department wishing to implement the materials contact her for further advice on integrating the package into the existing curriculum.

**Package:** Instructor's Manual (20 pages); and the software (41 interactive BASIC programs and 41 text file-builder programs, one per program, grouped into 7 modules). Most programs are about 250 lines in length, the largest being 550 lines (array usage is small). Most of the text files are about 250 lines long, the longest being 600 lines. *Level 0 except for Level 1 sequential file input and Level 2 file LINPUT.*

**Version:** BASIC

### SPANCOM

**Registry #:** HUM203

**Topics:** Spanish tense-moods and pronouns

**Suggested courses:** Elementary Spanish, Intermediate Spanish (for review)

**Author:** Herbert P. Weller (Hope College, Michigan), CONDUIT, Iowa City, Iowa, 1978.

*Spancom* is a series of twenty six in teractive drills in writing Spanish verbs and single object pronouns in any of twelve tense-moods. The unit includes 106 verbs and covers all of the verb morphology (except progressive forms) in *A Foundation Course in Spanish* (Turk, Third Edition, Heath Publishing Co.). The tense-moods covered by the materials include: present, im perfect, future, present perfect, and pluperfect indicatives; preterit; conditional; present and imperfect (both ra and se forms) subjunctives; affirmative and negative imperatives; and reflexive, indirect and direct object pronouns.

The first twenty-five drills correspond to the twenty five chapters in the Turk text. However, the drills themselves are independent of any text, and may be used in conjunction with a text of the instructor's choice.

Drill 26 allows the student to work on special problems.

The maximum number of verbs included in any one drill is twenty. The selection of verbs for each drill is based on the frequency of usage, and representativeness of new grammatical features.

Each drill presents up to twenty-five randomly generated cues. The drill is terminated whenever the student gets ten consecutive verbs correct or accumulates twenty errors.

**Package:** User's Manual (65 pages); Instructor's Guide (10 pages); and software (26 interactive BASIC drills in 32 program modules, 3 course management programs, 6 input data base files, and recordkeeping files). The programs do not exceed 600 lines each. All of the data files are small except one file that contains 3,200 eight item records. You should expect implementation of this package to be nontrivial. *Level 0 except for Level 1 CHAIN, program size, computed GOTO, ASCII character set, string arrays; and Level 2 direct access input/output files, many files, parameter passage between CHAINED programs.*

**Version:** BASIC

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## Management Science

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### BUSINESS DECISION SIMULATION

**Registry #:** MSC110

**Topics:** pricing, investment, production management, inventory marketing, negotiation

**Suggested courses:** Introductory Business, Business Policy, Production/Operations Management.

**Author:** J. Ronald Frazer, Reston Publishing Company, Reston, Virginia, 1975.

This package of twenty business games provides a wide variety of simulation experiences for the introductory business student as well as the advanced business student. The games are sufficiently simple in concept to allow students with varied backgrounds to play the games successfully. Yet, they are sufficiently complex to provide a challenge for students with advanced skills. The simulations pose problems ranging from simple price-production problems to relatively complex management science problems, and include some negotiation situations. Strategy, negotiation, and management science are stressed in the games. The "interactive" feature of the games allows the return of decision results to students in a matter of minutes. Thus, many decision-making periods can be covered quickly, compressing years of simulated activity into a short laboratory. Most of the games can be played in two hours, and require six to ten decisions.

**Package:** Student Manual (158 pages); Teacher's Manual (216 pages); software (17 interactive BASIC programs, ranging from 106 to 370 lines of code). *Level 0 except for Level 1 MAT ZER, but no other MAT operations.*

**Version:** BASIC



## BUSINESS MANAGEMENT LABORATORY

**Registry #:** MSC055

**Topics:** business policies, production management, financial management, marketing management

**Suggested courses:** Business Policy, Introductory Business

**Authors:** R. L. Jensen and D. J. Cherrington, Business Publications, Inc., Dallas, Texas, 1977 Revised Edition. Revised by CONDUIT, February, 1979.

This simulation presents a stylized model of a flatware manufacturing industry, allowing up to eight competing firms managed by student teams. The simulation can be varied in complexity by the administrator and thus is adaptable to various situations — introductory level management and business courses, graduate level policy courses, executive development conferences, and in-company training programs.

Firms are managed by student teams who "replace" the previous management. Each team competes for the product market, starting from essentially the same position and with the same product.

**Package:** Student Manual (118 pages); Administrator's Manual (644 pages); software (batch FORTRAN program, 3,100 lines of code).

**Version:** FORTRAN

## COMPUTER AUGMENTED CASES IN OPERATIONS AND LOGISTICS MANAGEMENT

**Registry #:** MSC008

**Topics:** operations management, operations research, production management

**Suggested courses:** Production Management, Operations Research and Management, Marketing Management, Quantitative Methods

**Authors:** Wm. Berry and D. Clay Whybark, Southwestern Publishing, Cincinnati, Ohio, 1972.

By running these 20 cases designed for instruction in operations and logistics management, students learn heuristic reasoning in modern management decision-making, and use of the computer as an aid to calculations. They also experience the motivating influence of being involved in solving realistic problems.

These cases treat a broad range of operations management issues drawn from several operating environments: manufacturing, service, and logistics systems. Several cases have an international flavor and are drawn from the authors' experience overseas. Despite the breadth of the industry and geographical environments, the intent is very nearly the same in each case. The purpose is to provide a vehicle for understanding and exploring certain decision issues. The cases also serve as an introduction to simulation analysis. In most instances the students' job will be one of deciding how to use the existing computer program to provide the bases for decision making and managerial action.

The process involved in analyzing these cases also introduces the question of experimental design for conducting the simulation experiments.

**Package:** Student Manual (325 pages); software (10 batch FORTRAN programs, ranging in size from 166 to 787 lines of code).

**Version:** FORTRAN

## COMPUTER MODELS IN OPERATIONS MANAGEMENT

**Registry #:** MSC007

**Topics:** management analysis, production management, operations management

**Suggested courses:** Operation and Systems Analysis, Production Management and Systems, Marketing Management

**Authors:** Roy D. Harris and M. J. Maggard, Harper & Row, New York, New York, Revised Edition, 1977. Revised by CONDUIT, February, 1979.

This collection of cases and accompanying programs can be used to demonstrate quantitative techniques for management analysis and decision-making. The purpose of the models is to introduce students, at the undergraduate or graduate level, to the use of the computer and quantitative techniques as a manager's tool in production or operations management. Text chapters present (1) theories and concepts of the model, (2) a simple hand-computed example, (3) sample input/output, (4) more complex problems, and (5) computer program listings. The student is assigned a problem, analogous to a case presented in the text, and makes independent use of the programs and techniques described to solve the problem. Use of the computer allows the student to concentrate on the structure of the problem, the data required, and analysis of the results in cases of realistic complexity.

The programs include a statistical forecasting model; an inventory system model; a model for inventory ordering policy; a decision tree analysis model; a project scheduling model; an assembly line balancing program; a model on statistical control charts; a maintenance policy simulation; a model for queuing systems; and a one product company simulation.

**Package:** Student Manual (219 pages); Instructor's Solutions Manual (201 pages); software (12 batch FORTRAN programs, ranging in size from 156 to 68 lines of code).

**Version:** FORTRAN

## COMPUTER MODELS IN OPERATIONS RESEARCH

**Registry #:** MSC084

**Topics:** stochastic processes, cost-effectiveness, mathematical programming, networks, statistical decision theory

**Suggested course:** Operations Research  
**Authors:** R. D. Harris, M. J. Maggard, W. G. Lesso, Harper & Row, Publishers, New York, New York, 1974.

This package of twelve computer models and accompanying text is designed to demonstrate how the computer can be used as a tool in applying scientific methodology to decision-making. The models generally represent the computer-based applications of operations research in the areas of mathematical programming, networks, statistical decision theory, stochastic processes, and cost-effectiveness methodology. Each model is presented in the text with an introduction to the theory used in the computer model; a simple hand-computed example problem; the correct input and resulting output for the computer model solution to the example problem; and more complex problems that suggest the full range of uses of the computer model. These problems are intended to provide students with practice in problem formulation, data gathering, sensitivity analysis, and reporting of results.

**Package:** Student Manual (244 pages); Instructor's Manual (217 pages); software (12 batch FORTRAN programs, ranging from 165 to 682 lines of code).

**Version:** FORTRAN

## EXECUTIVE GAME

**Registry #:** MSC054

**Topics:** financial management, accounting, marketing management, production management, business policies

**Suggested courses:** Business Policy, Introductory Business, Microeconomics

**Authors:** Richard Henshaw and James Jackson, Richard D. Irwin, Inc., Homewood, Illinois, Third Edition, 1978. Revised by CONDUIT, February, 1979.

This game is designed to introduce participants to the role of top management, requiring students to deal simultaneously with decisions in production, marketing, finance, and competition. Two models at differing levels of complexity make the game suitable for either beginning or advanced students in business courses.

Students are organized into teams of, ideally, four members who operate hypothetical companies in competition with each other. Teams make quarterly decisions on price of product, marketing budget, research and development budget, production volume scheduled, investment in plant and equipment, purchase of materials, and dividends declared.

**Package:** Student Manual (189 pages); Instructor's Manual (45 pages); software (2 batch FORTRAN programs, 422 and 123 lines of code).

**Version:** FORTRAN



## FINANSIM

**Registry #:** MSC035

**Topics:** financial management, cash budgeting, ratio analysis

**Suggested courses:** Managerial Finance, Corporate Finance

**Authors:** P.S. Greenlaw, M.W. Frey, and I.R. Vernon, West Publishing Company, St. Paul, Minnesota, 1979, Second Edition. Revised by CONDUIT, January, 1980.

FINANSIM provides an exercise in financial management decision-making and problem-solving. The unit may serve as a frame of reference or focal point for courses which include the subjects of analysis of financial statements, cash budgeting and ratio analysis.

Each FINANSIM firm produces and sells an unnamed, unidentified product. For each period of play (one year), managers make decisions to: determine the number of production units to be manufactured; purchase or sell marketable securities; float new or retire existing ten-year debentures; obtain bank-term loans to help finance company operations; issue new common stock; make dividend payments on existing common stock; maintain or expand the firm's plant and machine capacity; invest in any or all of three different types of capital improvements.

Numerous changes have been incorporated into the second edition, although the basic rules of play have remained the same. The FINANSIM environment has been made more difficult and challenging by changing parameters that make it more difficult to earn unrealistically "high" profits. Additional conceptual tools have been added to the student text. A discussion of accounting (or average) rate of return has been added, as well as a discussion and examples of the internal rate of return method. The authors have also emphasized two areas which have become more prominent since the first edition was published: net present value and finance decision making under conditions of risk and uncertainty. For each of these new topics, problems for students to work out are incorporated in the text and all quantitative problems appearing in the first edition of the student text have been modified.

**Package:** Student Manual (232 pages); Instructor's Manual (106 pages); software (batch FORTRAN program, 850 lines of code).

**Version:** FORTRAN

## MARKETING IN ACTION

**Registry #:** MSC048

**Topics:** marketing management, production management

**Suggested courses:** Introductory Marketing, Marketing Policy and Planning

**Authors:** Ralph Day and Thomas Ness, Richard D. Irwin, Inc., Homewood, Illinois, Fourth Edition, 1978. Revised by CONDUIT, February, 1979.

This package provides a sufficiently realistic business context for students to test marketing decisions, such as purchasing marketing research studies, setting prices, making product line decisions, scheduling production, and allocating promotional

dollars to both advertising and sales. The instructor can vary parameters in the environment, the number of teams (three to six), and regions (up to 99). This flexibility allows maximum adaptability in the application of the program. The program is especially useful for teaching introductory marketing, and the program requires little or no computer background for effective use. In order to succeed in this game, a team must learn how a business executive makes marketing decisions and how to evolve and maintain an effective strategy for firm operation.

This newest fourth edition includes the capability to accept optional advertising copy and/or media schedules from students, a research study to measure the quality of the advertising copy/media schedules submitted, and a research study to estimate the impact on demand of consumer attitudes toward container type. A number of improvements in the computational model, in error detection and in the administrator output, will be noticeable to previous users.

**Package:** Student Manual (68 pages); Instructor's Manual (60 pages); software (batch FORTRAN program, 1,030 lines of code).

**Version:** FORTRAN

## SIMQUEUE

**Registry #:** MSC039

**Topics:** queueing theory, first-in/first-out

**Suggested course:** Quantitative Techniques

**Author:** Gary Wicklund (The University of Iowa), CONDUIT, Iowa City, Iowa, 1969.

Students are allowed to manipulate input data and observe changes in output for a simulated system consisting of parallel single server channels with first-in, first-out queues. This provides information on the relationship of different queues, arrival rates, number of service stations, arrival distributions, cost of servers, and costs of units waiting for service.

**Package:** Student Manual (57 pages); software (batch FORTRAN program, 860 lines of code).

**Version:** FORTRAN

## TEMPOMATIC IV

**Registry #:** MSC042

**Topics:** production management, business policies

**Suggested courses:** Business Policy, Production, or Operations Management

**Authors:** Olice Embry, Alonzo Strickland, and Charles Scott, Houghton Mifflin Co., Boston, Massachusetts, 1974.

This business game allows the instructor to select any of nine demand curves and control major variables in order to simulate various situations in the operation of a business enterprise. Students form management teams or companies, and, on an introductory level, learn about business operations by trial and error. On an advanced level, they apply and test quantitative tools.

**Package:** Student Manual (77 pages); Instructor Manual (63 pages); software (batch FORTRAN program, 2,591 lines of code).

**Version:** FORTRAN

## Mathematics

### ALGEBRA DRILL AND PRACTICE

**Registry #:** MTH229

**Topics:** algebraic signs, operations with numeric and algebraic fractions, percents, equations of lines, simplification of algebraic expressions, word problems

**Suggested courses:** Algebra (Elementary, Intermediate, College or Remedial)

**Authors:** R.C. Detmer and C.W. Smullen (University of Tennessee at Chattanooga), CONDUIT, Iowa City, Iowa, 1979.

This package will enable instructors to provide drill, practice, and help for students of algebra with little direct instructor involvement. Once the student knows how to manage the technical details of the program, such as how to answer the computer, the programs provide all the guidance necessary. For maximum effectiveness, the student should be taking a course in algebra and the use of the package should be keyed to the pace of the course. While these programs are clearly not a substitute for the teaching/tutorial role of the instructor, they do provide the student with virtually unlimited numbers of example problems and their detailed, step-by-step solutions.

The problems start at an easy level and progress to sufficiently challenging ones for the college-level remedial student. The package consists of nine programs for the following skills:

ALCOMY provides drill and practice with addition, subtraction, multiplication, division, and reduction of algebraic fractions.

FRACTS provides drill and practice with addition, subtraction, multiplication, division, and reduction of numeric fractions.

SIMPLE provides drill and practice with simplifying algebraic expressions, including addition, subtraction, and use of the distributive property.

LINES provides drill and practice with finding slopes and equations of lines.

SIGNS provides drill and practice with signed numbers and with the order of arithmetic operations.

PERCNT provides drill and practice with percents.

DISTNC provides drill and practice with setting up and solving word problems involving the formula  $D = R \cdot T$ .

RCTNGL provides drill and practice with setting up and solving word problems involving lengths, widths, and perimeters of rectangles.

SOLNS provides drill and practice setting up and solving word problems involving mixing solutions of different strengths.

**Package:** Instructor's Manual (90 pages); software (9 BASIC programs, 300 to 1,500 lines of code). *Level 0.* Note that the programs do use Level 0 string manipulation, substrings and concatenation.

**Version:** BASIC



## BERTIE

**Registry #:** MTH047

**Topics:** logic, natural deduction

**Suggested course:** Introduction to Formal Logic

**Authors:** James Moor and Jack Nelson, COMPRESS, Inc., Wentworth, New Hampshire, 1974.

*Bertie* checks deductions in sentential logic and in quantificational logic (with identity) using the set of rules for natural deduction found in *Elementary Symbolic Logic* by Wm. Gustason and Dolph Ulrich. As the student enters each line of the deduction, *Bertie* checks it to be sure the formula is well-formed and correctly justified. The immediate feedback from *Bertie* on the correctness of the deduction prevents the perpetuation of incorrect knowledge, reinforces correct use of logic, and quickens the learning process.

*Bertie* is equipped with fifty problems selected to illustrate various techniques of natural deduction. If the student has difficulty solving a problem, *Bertie* will provide a set of hints, and will also provide lines of the solution stored in *Bertie* to help the student understand the basic techniques used to solve the problem. If the student is still unable to solve the problem, *Bertie* will print the complete deduction. Students may enter their own problems for the program to check, but *Bertie* cannot supply help in solving these problems.

*Bertie* is a very large program, both in terms of number of lines (about 2,600), and size and number of arrays (about 3,000 total elements). It may prove to be too big for all but large mainframe computers. Though not impossible to implement in interpretive BASICs, the program is better suited for compiler BASICs. One of the routines in *Bertie* is recursive (calls itself). If your dialect of BASIC does not accept this feature, implementation of the package will be very difficult.

CONDUIT has attempted to solve the problem of size by including in the package a "subroutine version" of *Bertie*, consisting of a main routine and twelve subroutines. This version requires active storage of the main routine (545 lines) and, at most, one other subroutine (largest subroutine, 390 lines).

**Package:** A Manual for *Bertie* (60 pages); software (3 BASIC versions of the program and 2 data files). Version 1 uses multiple line user-defined functions (2,614 source code lines). Version 2 does not use multiple line user-defined functions (2,907 source code lines). Version 3 includes 13 subroutines ranging in size from 65 to 545 source code lines. All versions use the same two data files (181 and 1,413 items) which are read sequentially as 80-character records. Implementation difficulties may arise due to program size (source code lines and array elements) and file capabilities.

*Level 0 except for Level 1 ASCII characters (uses table lookup to get ASCII equivalents - could be replaced), sequential file input, array element zero (only used by CHANGE statement - ORD, CHR\$); and Level 2 program size, multiple-line user defined functions (in 2 of 3 versions), (CALL in subroutine version), LINPUT, ORD and CHR\$.*

**Version:** BASIC

## COMPUTER LABORATORY IN CALCULUS AND LINEAR ALGEBRA

**Registry #:** MTH150

**Topics:** calculus, linear algebra, multivariable calculus

**Suggested courses:** Computer-oriented Calculus, Linear Algebra

**Author:** K. D. Stroyan (The University of Iowa), CONDUIT, Iowa City, Iowa, 1978.

This package provides a computer-based laboratory to supplement courses in calculus of one and several variables, and linear algebra, with some attention to differential equations. It attempts to steer a middle course between a "black box" approach, and having students program the answers. The programs are provided, for the most part, but students must learn enough BASIC to understand the programs, enter function definitions, and make other modifications to the program.

Along with a brief introduction to BASIC and the use of interactive terminals, the manual has four sections, each of which might be a supplement for a one-semester course, although most instructors would find some juggling necessary to fit their particular courses. Part One is concerned with numerical illustration of basic concepts in calculus: limits, derivatives, integrals, root finding, graphing and exponential growth. Part Two covers numerical methods for integration, approximation, and evaluation of series, including Taylor and Fourier series. Part Three is on linear algebra, including standard topics, such as solution of equations, linear dependence, inverses, determinants and eigenvalues, as well as some less standard ones, such as Markov chains and linear programming. Part Four covers topics in multivariable calculus: differential systems, optimization, nonlinear algebraic systems, and linear and quadratic approximation. Since Part Four depends on Part Three, the structure is well-suited for course sequences covering linear algebra before multivariable calculus.

**Package:** Laboratory Manual (300 pages); software (27 BASIC programs ranging in size from 23 to 117 lines of code). *Level 0 except for Level 1 MAT input and functions in some programs.*

**Version:** BASIC

## COMPUTER-ORIENTED COURSE IN LINEAR ALGEBRA

**Registry #:** MTH002

**Topics:** linear algebra, echelon, reduced echelon, orthonormal bases, polynomial coefficients, simplex method

**Suggested course:** Linear Algebra

**Author:** Donald McLaughlin (Augustana College), CONDUIT, Iowa City, Iowa, 1974.

This text presents topics in linear algebra utilizing the computer to help teach introductory students: (1) some of the theory and main results of linear algebra; and (2) the algorithmic nature of relevant topics, such as vector spaces, systems of linear equations, matrices, linear transformations, and linear

programming. Students write simple computer programs to implement the proofs of important theorems utilizing four strategic subroutines and a simulation provided in the text.

**Package:** Student Manual (180 pages); software (4 batch FORTRAN subroutines, ranging in size from 23 to 25 lines of code, and 1 batch FORTRAN program, 168 lines of code).

**Version:** FORTRAN

## COMPUTER SUPPLEMENT FOR LINEAR ALGEBRA

**Registry #:** MTH104

**Topics:** matrices, linear equations, linear map, values, vectors, determinants, characteristic polynomials, Gram-Schmidt Process, independence and bases, rank, kernel

**Suggested courses:** Linear Algebra, Matrix Algebra

**Author:** John B. Fraleigh (University of Rhode Island), CONDUIT, Iowa City, Iowa, 1977.

The materials in this package are intended to supplement a sophomore or junior level course in linear algebra or matrix algebra. Their purpose is to reinforce students' understanding of concepts and of problem-solving techniques by providing computational experience with more substantial problems than would be possible using only hand computations or a calculator. The materials were designed to be used in conjunction with *A First Course in Linear Algebra* by John B. Fraleigh and Raymond Beauregard (Houghton Mifflin, 1973). However, the CONDUIT reviewers found the materials to be suitable for use with any standard linear algebra text.

The package includes seven BASIC programs and a student manual. The student manual is divided into ten projects in the areas of: matrix operations; systems of linear equations; inversion of matrices; independence and bases; coordinates and change of basis; rank, kernel, and image of a linear map; characteristic values and vectors; determinants; characteristic polynomials, values, and vectors; and the Gram-Schmidt process. Each project concludes with exercises that the student is expected to complete using the seven supplied computer programs.

**Package:** Student Manual (51 pages) and software (7 interactive BASIC programs, ranging in size from 112 to 307 lines of code). *Level 0 except Level 1 computed GOTO, MAT INPUT, TRN, INV and DET.*

**Version:** BASIC



## INTERFACE: CALCULUS AND THE COMPUTER

**Registry #:** MTH105

**Topics:** roots, numerical integration, pi, differentiation, transcendental functions, initial-value, series, sequences and limits

**Suggested courses:** Computer-oriented Calculus or Calculus with Computing

**Author:** David A. Smith, Houghton Mifflin Company, Boston, Mass., 1976.

This supplementary calculus text is designed for use in a variety of classroom for mats, from a few hours of supplementary computer work, to a complete semester course based on computer use. Each chapter of the text is a small unit allowing the instructor maximum flexibility in matching the content and pace of the material to the basic course. Each topic is covered by several of these chapters, or sections, including an introduction to the concept; introduction of the computer program and how to use it; further, in-depth discussion of the concept; background reading; and bibliographic references. Topics presented include: sequences and limits, computation of pi, roots of equations, max/min problems, integration, differentiation, transcendental functions, initial-value problems, and evaluation of series. The student is required to write small (ten-line) computer programs.

The text includes a general introduction to computer programming, brief introductions to FORTRAN, BASIC and PL/I, and sample programs in these languages.

**Package:** Student Manual (260 pages), Instructor's Manual (158 pages); software (33 interactive FORTRAN programs ranging from 9 to 89 lines of code or 33 interactive BASIC programs ranging from 8 to 85 lines of code). *Level 0*.

**Versions:** BASIC, FORTRAN

## MATHPROGRAM

**Registry #:** MTH243

**Topics:** elementary calculus concepts including differential equations

**Suggested course:** Freshman Calculus

**Authors:** R.C. Barr, T.M. Gallie, Jr., M.J. Hodel, R.E. Hodel, F.J. Murray, D.A. Smith, D.A. Smith, II (Duke University), CONDUIT, 1978.

MATHPROGRAM is a general sequence generator intended for use in calculus instruction. The program tabulates from one to seven recursive sequences. The student provides: definitions of any functions that may be needed; a rule for starting each sequence used; a rule for advancing from the (n-1)th term to the nth term for each sequence; and values for any input parameters (constants). To use the program, students need only know how to access the program at a terminal, how to program arithmetic expressions and assignment statements, and how to type a small number of statements for each execution of the program. The small amount of BASIC needed is covered in the Student Guide.

The Student Guide also provides direction for the use of the program for sequence generation, function tabulation, and series evaluation, and then proceeds to use these as tools in many topics of calculus. The manual contains specific problems on the following topics:

*Calculus of one variable:* function tabulation and applications; miscellaneous sequence explorations; numerical differentiation; roots of equations; numerical integration and the Fundamental Theorem of Calculus; polynomial approximation to transcendental functions; exponential limits; initial value problems; and infinite series evaluations.

*Multivariable calculus:* vector valued functions; functions of two variables; function tabulation over a rectangle; numerical integration over a rectangle; simultaneous solutions of nonlinear equations and max/min problems; and linear regression (least squares).

The materials are intended to motivate and reinforce the theoretical concepts of calculus through the use of numerical examples. It may be used in a laboratory which accompanies a calculus course or, in a more limited way, in the course itself.

**Package:** 5 copies of Student Guide (60 pages); Instructor's Guide (40 pages); software (interactive BASIC program, 700 lines of code) *Level 0*.

**Version:** BASIC

## SURFACE

**Registry #:** MTH152

**Topic:** three-dimensional surfaces in two-space

**Suggested courses:** Calculus and Analytic Geometry, Multivariate Calculus, Pre-Calculus

**Author:** David A. Smith (Duke University), CONDUIT, Iowa City, Iowa, 1978.

To go significantly beyond the blackboard level of presentation of plane projections from three-space, some assistance is needed from a computer, both for determining coordinates of points and for graphic display. Although computer technology for this task is available, it seldom reaches the classroom because of the cost of these highly specialized devices. The Surface package solves this problem by making graphing available through a high- or medium-speed line printer. With minor adjustments, Surface can also be used with hard-copy interactive terminals. Unlike many other programs for plotting contour maps of surfaces, Surface is inexpensive, easily used by novices, and displays the visual information in the form most commonly found in textbooks and in the classroom.

Students simply input the function [ $Z = f(x,y)$ ] they want to graph by changing one line in the program.

The accompanying Student Manual includes detailed instructions for using the program with many examples and exercises. Topics covered in the manual include domains, scaling and positioning, rotation, and quadratic surfaces.

**Package:** Student Manual (41 pages); software (FORTRAN, 210 lines of code, or BASIC, 176 lines of code). *Level 0 except for Level 1 string variable length*.

**Versions:** BASIC, FORTRAN

## Physics

### ICBM I: INTRODUCTORY COMPUTER BASED MECHANICS I

**Registry #:** PHY053

**Topics:** mechanics, numerical integration

**Suggested course:** Introductory Physics

**Authors:** A. Bork, A. Luehrmann, and J. Robson, CONDUIT, Iowa City, Iowa, 1976.

This text is partially intended as an introduction to computer use in physics. It is written for an introductory general physics course and could be used for nonscience majors. The programs are listed in the text and are written in BASIC, FORTRAN, JOSS and PL/I. The material is intended to comprise one week of instruction in the physics of the harmonic oscillator, without calculus, for either physics or nonphysics majors. The materials should complement, rather than supplant, the standard mathematical analysis by enabling the student to explore a broader range of problems. The text is organized into three lectures and a laboratory session including seven problems with computer-calculated solutions.

**Package:** Student Manual (54 pages); Teacher's Guide (55 pages); software (programs listed in the text in BASIC, FORTRAN, JOSS and PL/I; not provided in machine readable form).

**Versions:** BASIC, FORTRAN

### ICBM II: INTRODUCTORY COMPUTER BASED MECHANICS II

**Registry #:** PHY092

**Topics:** mechanics, Newton's Second Law, projectile motion, Kepler's Laws, gravitational force

**Suggested Course:** Introductory Physics

**Authors:** A. Bork, W. Lang, J. Merrill, and H. Peckham, CONDUIT, Iowa City, Iowa, 1974.

## Revised Edition of ICBM II

CONDUIT has recently published a revised edition (Second Edition) of *Introductory Computer-Based Mechanics II* (CONDUIT Registry #PHY092). The revised manual includes listings of PASCAL versions of the programs, as well as the FORTRAN, BASIC, and APL versions included in the first edition. Since the programs are not distributed on magnetic tape, one need only purchase a copy of the new manual to obtain these new program versions.



ICBM II focuses on the iterative solution of Newton's Second Law ( $F = ma$ ) using two- and three-dimensional solutions, and introducing advanced numerical techniques with exercises for teaching students to apply concepts and skills. Topics covered include: (1) algorithmic solution of Newton's Second Law; (2) projectile motion; (3) satellite motion around a single gravitational force center; (4) Kepler's Laws; (5) satellite motion in a system with two fixed gravitational force centers; and (6) alternate calculations of Newton's Second Law using potential instead of force.

**Package:** Student Manual (38 pages); software (programs listed in the text in APL, FORTRAN, PASCAL, and BASIC; not provided in machine readable form).

**Versions:** BASIC, FORTRAN

## ★ INTERP

**Registry #:** PHY183

**Topics:** wave superposition, diffraction patterns

**Suggested course:** Introductory Physics

**Author:** John Harris, Chelsea Science Simulation Project, Chelsea College, London, 1976.

This unit on wave superposition is designed to improve students' understanding of the use of models in physics. It pays particular attention to the wave theory of light and to how effective the theory is in explaining observed phenomena.

The Students' Notes provide information that guides the student through three investigations of interference and diffraction phenomena using the computer program. The simple model in the program calculates the intensity due to the superposition of radiation from two sources, or two slits, each having two secondary sources. The complex model in the program allows students to investigate the effects of the number of secondary sources in each slit.

This unit is not intended to replace the usual teaching of interference and diffraction phenomena. It cannot in any way replace actual observation of these patterns, which are, after all, easily enough seen using simple laboratory equipment. The aim is to focus students' attention on the physical model used to "explain" the observations in a way that, because of the mathematics involved, is not simple to do without a computer. The work is intended to encourage a more critical attitude toward the use of models in physics in general, by emphasizing and investigating some of the assumptions (nearly always made but hardly ever mentioned) in this one example.

**Package:** Six copies of Students' Notes (11 pages); one copy of Teachers' Guide (15 pages); software (interactive BASIC program, 284 lines of code). *Level 0*.

**Versions:** BASIC, Apple, PET, TRS-80

## MECHANICS

**Registry #:** PHY057

**Topics:** physical mechanics, velocity, displacement, Newton's Second Law

**Suggested course:** Introductory Physics

**Author:** Herbert Peckham, Scientific Press, Palo Alto, California, 1972.

Peckham's 28 computer-oriented exercises supplement traditional instruction in mechanics, allowing students to progress through increasingly difficult computer-oriented problems while developing logical, analytical tools, and computing skills in the BASIC programming language. Simple BASIC programs are included which serve both as illustrative and calculation tools: (1) Average Velocity (11 lines of code); (2) Displacement (13 lines of code); and (3) Newton's Second Law (21 lines of code).

**Package:** Student Lab Manual (32 pages); Teacher's Adviser (30 pages); software (programs listed in the text in BASIC; not supplied in machine readable form). *Level 0 except for Level 1 array element zero*.

**Version:** BASIC

## ★ NEWTON

**Registry #:** PHY130

**Topics:** Newton's Laws, gravitation, velocity

**Suggested course:** Introductory Physics

**Author:** J. Harris, Chelsea Science Simulation Project, Chelsea College, London, 1975.

This unit is designed to help the student achieve an appreciation of how the application of Newton's Second Law and Law of Gravitation leads to the prediction of satellite orbits. The computer program on which this unit is based uses an iterative method to calculate the path of a projectile launched horizontally. The student is instructed to find the initial velocity needed for the minimum (circular) orbit.

**Package:** Six copies of Students' Notes (10 pages); one copy of Teachers' Guide (11 pages); software (interactive BASIC program, 134 lines of code). *Level 0*.

**Versions:** BASIC, Apple, PET, TRS-80

## QUANTUM MECHANICS

**Registry #:** PHY006

**Topics:** quantum mechanics, Schrodinger's equation

**Suggested course:** Introductory Quantum Mechanics

**Author:** John R. Merrill, Scientific Press, Palo Alto, California, 1974.

This text, dealing with numerical solutions to Schrodinger's equation, is designed to extend a student's knowledge of quantum mechanics through computer use. Some background in introductory quantum mechanics is required, and a rudimentary knowledge of the BASIC programming language for performing computer-dependent exercises. Topics include: (1) one-dimensional bound states; (2) three-dimensional, time-dependent Schrodinger's equations for time-dependent potentials; and (3) three-dimensional continuum states for spherically symmetric potentials.

**Package:** Student Manual (77 pages); software (programs listed in the text in BASIC; not supplied in machine readable form).

*Level 0 except for Level 1 computed GOTO and array element zero.*

**Version:** BASIC

## ★ SCATTER

**Registry #:** PHY129

**Topic:** nuclear scattering

**Suggested course:** Introductory Physics

**Author:** J. Harris, Chelsea Science Simulation Project, Chelsea College, London, 1975.

This package contains three models simulating experiments for student investigation of particle scattering. The experiments are:

1) "Marbles" are scattered by hard, massive objects of regular shape. From the scattering produced, students can infer the shape and size of the object.

2) The particles are scattered by a hard object or by an "inverse-square scatterer." In the latter case the particle's energy has an effect on the scattering produced and the "size" of the scattering object depends on the energy of the probing particles. Once again students are asked what the scatterer is and to estimate its "size."

3) A simulation of scattering of alpha particles by a thin foil, using a simple nuclear model. Students can vary parameters (metal, foil thickness, energy of alpha particles) and are asked to decide, on the basis of their own "experiments" whether a hard sphere or inverse square scattering model of the atoms in the foil was used, and also to check predictions of this model against actual experimental results.

The shape and size of the objects in the first two programs are determined by random numbers generated by the computer. Thus they really are unknown to the student (and the teacher), neither of whom knows the "right" answer.

**Package:** Six copies of Students' Notes (15 pages); one copy of Teachers' Guide (17 pages); software (3 interactive BASIC programs, ranging in size from 142 to 178 lines of code). *Level 0*.

**Versions:** BASIC, Apple, PET, TRS-80

## USING COMPUTERS IN PHYSICS

**Registry #:** PHY003

**Topics:** mechanics, thermodynamics, statistical physics, static electric fields, vector calculus, magnetic fields, relativity, circuit theory, geometrical optics, Fourier analysis and wave propagation, wave addition, quantum mechanics, nuclear decay solid-state physics

**Suggested course:** Introductory Physics

**Author:** John R. Merrill, Houghton Mifflin Company, Boston, Mass., 1976.

The materials in this package are designed to show students ways in which the computer can be used to increase their intuitive understanding of physics. Students must understand the principles of physics presented in lectures and readings to successfully apply the concepts to computer programs, and to produce examples of the physics discussed in the course. Also, students can be exposed to a broader range of problems since using the computer relieves them of the burden of hand computation.



## The Best of Pipeline



*Best of Pipeline*, a special issue of *Pipeline*, presents a series of snapshots reflecting the development of CONDUIT's goals and activities, and represents the development of computer-based education since 1974. Today it is difficult to believe, for example, that in 1974 microcomputers were rarely mentioned in the discussion of instructional computing. This special issue also fills a void that we have found in the literature — that there are few texts or readings that tell of computer-based education.

The *Pipeline* has been our forum for presenting and discussing ideas about computing in higher education. Our articles have been read, reprinted, and criticized, and we have received many requests for issues that are out of print. In putting together this issue, because of interest and in part to meet demand for past issues, we reviewed the eight issues of the *Pipeline* published since 1974. We were surprised with the thought-provoking quality of many of the articles. We hope you will find them as interesting on first reading as we did on the second.

The articles run a broad gamut of topics but all are related to the use of computing in higher education. The changing role of the computer center in promoting instructional computing, the uncertain role instructional computing should play as part of a total curriculum, and, of course, the impact of microcomputers, all reflect and have contributed to the changing scene of computing.

To order your copy of *Best of Pipeline*, use the attached Information Card.

The package includes sixty-three computer programs and a supplementary text designed to be used with any standard course textbook. A full presentation of the concept must come from the course text; the package text includes only a brief statement of the equations and laws.

The materials treat a wide range of subject matter, and most likely provide broader coverage than is required for a single course. Each chapter in the package text can be used as a separate unit allowing the instructor to select the appropriate units for the course.

**Package:** Manual (258 pages); software (60 interactive BASIC programs, ranging in size from 43 to 205 lines of code). *Level 0* except for *Level 1* MAT READ.

**Version:** BASIC

Legislative Project. This data set is used to supplement the questions by Almond and Verba. It cannot be combined with the data from the four countries, since most of the questions are quite different from those used by Almond and Verba.

**Package:** Student Manual/Codebook (53 pages); Notes to Instructor (8 pages); software (data file [65 variables and 2,000 cases] for use with SPSS or any similar statistical analysis package).

**Version:** data file

### INS2: INTER-NATION SIMULATION

**Registry #:** POL050

**Topics:** international relations, diplomacy, comparative politics

**Suggested courses:** International Relations, International Organization, World Politics, Comparative Foreign Policy-Making

**Authors:** Bahrām Farzanegan and Ronald Parker (N. C. Educational Computing Service), CONDUIT, Iowa City, Iowa, 1978.

INS2, Inter-Nation Simulation in Time-Sharing BASIC, is based on the *Inter-Nation Simulation* by Guetzkow and Cherryholmes (Science Research Associates, Inc., 1966). It improves on the original kit by eliminating the many manual calculations required of students and instructors. Time-consuming calculations are performed by the computer, leaving students free to concentrate on making decisions, formulating strategy, and implementing overall policy. Computer programs are provided for students to test their decisions on trade, budget, and war, and to project the consequences of their decisions during the simulation.

Likewise, INS2 relieves the instructor of many hours of tedious calculations, leaving him free to concentrate on the development of the simulation. The programs for the instructor provide summary sheets for each nation's characteristics, determine office holding, and provide a master statistics report

and an intelligence report.

In the simulation students assume government positions in hypothetical nations, and make decisions concerning budget, trade, military force, and war. The simulation format consists of a briefing, a trial run, several decision periods focusing on one problem (a scenario chosen by the instructor), and a debriefing. Twelve scenarios are included with the package. The simulation is generally run for four to eight periods, each lasting about one hour. Several additional hours are needed for preparation and post-game analysis, or debriefing.

By replicating the international system through the creation of a cluster of prototype nations, students are exposed to the complexities of decision-making in foreign policy, and the problems of trade, diplomacy, and war. INS2 also permits research into areas otherwise not open to research by conventional methods.

**Package:** SRA Participant's Manual (57 pages); CONDUIT Instructor's Manual (100 pages); CONDUIT Programmer's Guide (120 pages); software (12 interactive BASIC programs, ranging in size from 155 to 374 lines of code, and 12 data files, each 550 numeric data elements). *Level 0* except for *Level 1* sequential input/output files and file name as input.

**Version:** BASIC

### POLITICAL PARTICIPATION

**Registry #:** POL132

**Topics:** political participation, voting behavior, socioeconomic status

**Suggested courses:** Introductory Political Science, Political Behavior, American Government

**Authors:** C. Arterton and H. Hahn, American Political Science Association, Washington, D.C., 1975.

This data analysis package focuses on

## Political Science

### CITIZENS AND THE POLITICAL SYSTEM

**Registry #:** POL020

**Topics:** comparative politics, research methods, survey analysis

**Suggested courses:** Comparative Politics, Research Methods, Introductory Political Science

**Author:** G. R. Boynton, The University of Iowa, Iowa City, 1972.

This unit describes two studies and suggests how these data on public attitudes can be used to answer questions about politics. Two different data sets are used. The first data set utilizes a subset of items from a survey of public attitudes toward government in the U.S., Great Britain, West Germany, and Italy by Gabriel Almond and Sidney Verba, as reported in *The Civic Culture*. The second data set is taken from the Iowa



which describes the problem and includes some published research related to the problem of schizophrenia. Then the student designs an experiment by specifying the values of the independent variables available in the model — diagnosis of subject, familial relationship, nature of relationship (adopted or biological), type of diagnosis, method of diagnosis, and sex of subjects. The *Exper Sim* program then calculates the appropriate value of the dependent variable for the number of subjects specified by the student. The model algorithm, which computes the individual subject's score, provides for sampling error so that the scores derived from replications of an experimental design differ according to a distribution function specified by the computer model. Summary statistics are provided, and the student evaluates the results according to the original hypothesis. Based on these findings, the student proceeds to design additional experiments which, it is hoped, follow from previous ones. Finally, the student prepares a report of his or her research written in APA format, or makes a presentation of the findings in class. The instructor can shape the use of this model by directing students' attention to specific independent variables.

**Package:** Includes five copies of Student Guide (30 pages); Instructor's Guide (45 pages); software (interactive or batch FORTRAN, *Exper Sim* (MESS) student version driver (4,740 lines of code) and model subroutine (960 lines of code), and two small sequential data files.

**Version:** FORTRAN

## Sociology

### ★CHANGE AGENT

**Registry #:** SOC097

**Topics:** change agent, diffusion of innovation

**Suggested courses:** Social Psychology, Mass Communications, Social Change

**Author:** Charles Weinberg (Stanford University), CONDUIT, Iowa City, Iowa, 1976.

*Change Agent* is a simulation game intended to help students understand the role of a change agent and the strategies typically used by the change agent to accomplish diffusion of innovation. The student assumes the role of a change agent and develops and implements (via the computer program) a strategy for influencing change in a hypothetical farm community. (The scenario may be easily changed for any situation.) The student "purchases" information about the villagers, such as the percentage of villagers who read newspapers or listen to the radio. A total of seven types of information are available. For each purchase of information, a certain number of days is deducted from the student's total number of days given to achieve adoption (e.g., 50% adoption in 250 days). Based on this information, the student

then selects from seven diffusion strategies, such as using newspapers or the radio to create knowledge of the innovation. After each diffusion strategy the program informs the student of the resulting number of adopters. Chance events which affect the number of adopters occur randomly during play of the game, and serve to enhance the reality of the simulation.

**Package:** Student Manual (14 pages); Instructor's Guide (30 pages); software (interactive BASIC program, 385 lines of code).

*Level 0 except for Level 1 sequential input/output files, file name as input, string variable length, MAT READ, MAT PRINT, MAT ZER, multiple assignment statement, computed GOSUB, computed GOTO.*

**Versions:** BASIC, TRS-80

### CHANGING ATTITUDES TOWARD INTEGRATION

**Registry #:** SOC019

**Topics:** public opinion, social change, ethnic relations, research methods, survey analysis

**Suggested courses:** Social Psychology, Introduction to Sociology, Research Methods, Ethnic Relations

**Author:** G. R. Boynton, The University of Iowa, Iowa City, Iowa, 1972.

Variables from three national opinion surveys, conducted in 1946, 1966, and 1972, by the National Opinion Research Center of the University of Chicago, comprise this data set which deals with attitudes of whites toward blacks. The student is allowed to investigate the extent and nature of the change in the attitudes of whites between 1946 and 1972.

**Package:** Student Manual/Codebook (44 pages); Notes to Instructor (8 pages); software (data file [37 variables and 1,410 cases] for use with SPSS or any similar statistical analysis package).

**Version:** data file

### CUMULATIVE GENERAL SOCIAL SURVEY DATA FILE

**Registry #:** SOC163

**Topics:** social opinion, stratification, marriage and the family, race relations, social control, morale

**Suggested courses:** Marriage and the Family, Race Relations, Social Psychology, Social Change

**Author:** National Opinion Research Center, University of Chicago, and Roper Public Opinion Research Center, Williams College, 1978.

This data file combines the data from the annual NORC surveys from 1972 to 1978, and provides an excellent background for the study of many of our current sociological problems and trends. All questions from each year are included in the file, and the records for each case have been reformatted so that variable values are in the same location for each respondent (or case), thus making data for time series analysis readily available. In the process of merging the years, NORC included new data, made corrections to the data, and added refinements, such as further refinement of category responses.

Obviously, a major problem in using this file is its size (10,652 cases, 447 variables).

CONDUIT has included in the package suggestions for creating subfiles to make the data more manageable for undergraduates, and more cost-effective. The NORC Codebook also helps ease this problem with a thorough presentation of the data, and a cross tabulation of each question by year.

**Package:** Codebook (340 pages); software (data file [447 variables and 10,652 cases] for use with SPSS or any similar statistical analysis package).

**Version:** data file

### DEMO-GRAPHICS

**Registry #:** SOC164

**Topics:** demography, population growth and change

**Suggested courses:** Demography, Population Studies, Introduction to Sociology, World History, Public Administration

**Author:** Population Dynamics Group, University of Illinois, Urbana, Illinois, 1978.

The *Demo-Graphics* programs can be used to present current and historical demographic data for many nations; project multi-national populations given current trends; and facilitate understanding of demographic dynamics and the impact of both real and simulated factors affecting the growth of populations in the world.

The package is suitable for college students who are beginning to learn the outlines of the population/resource relationship, as well as for graduate students who are ready to attempt computer simulations to test hypotheses about the effects of various demographic variables on the population structure of the United States and other countries. Many high school students have also used the program with success. Any social science course which includes an introduction to demographic facts can benefit from use of the package, particularly because it can aid in the exploration of the causes of demographic facts or conditions.

The programs are easy to use, and are self teaching. No previous experience with computers nor previous knowledge of demography is necessary to use the programs. A minimum amount of preparation time is required for classroom use: a fifteen-minute introductory demonstration is usually sufficient to familiarize either students or instructors with the system. The User Manual which accompanies the programs gives complete directions and explicit examples which illustrate several of the many applications of the programs.

The programs include 1975 data on population, fertility, mortality and cereal production information for 136 countries. Space is also allocated for the addition of up to ten new countries or regions at the user's discretion. The user may also modify the data to reflect recent changes or estimates of present and future fertility and mortality values.

**Package:** User Manual (120 pages); software (12 interactive BASIC programs and 39 data files). The two-sex population projection program is very large, over 1,150 source code lines. Four of the other programs are also large, ranging from 740 to 960 source code lines. The data files range from 100 to 1,640 numeric values. *Level 0 except Level 1*



string variable length, sequential input/output files, program size (3 programs); and Level 2 program size (1 program).

**Version:** BASIC

### ★ PROFIS I, II, III

**Registry #:** SOC156

**Topic:** elementary bivariate table construction using demographic, world population data

**Suggested courses:** Introductory Sociology, Social Problems, Introductory Methods/Statistics

**Author:** George H. Conklin (North Carolina Central University), CONDUIT, Iowa City, Iowa, 1978.

These brief tutorials, each requiring approximately 30 minutes to complete, combine relevant content areas and introductory methodology in simple, easy-to-use computer-assisted homework assignments. *Profis I* discusses social facts that cause changes in birth rates. Through the example of the world population problem, the student explores the strength of relationships between birth rate and indicators such as per capita income by summarization in contingency tables and correlation measures (specifically, Yule's Q).

*Profis II* is concerned with the study of crime and with the determination of social indicators of crime. The concept of correlation between crime and social indicators, such as poverty, city finances, and population density, are extended to predicting crime through linear multiple regression.

*Profis III* illustrates the use of growth curves in the context of urbanization. Using New York City as a model, the student learns about the accuracy of prediction of urban growth through linear, exponential and s-shaped (logistic) curve models.

Each of the tutorials begins by introducing the student to the substantive issue involved. The tutorial then asks the student to "estimate" the effects of the particular issue. Next, the tutorial introduces facts (data) and guides the student through an analysis of the facts. In each case, the appropriate methodology is used. Finally, the student is given a homework assignment based on the facts given in the tutorial. The assignment requires the student to use the illustrated methodology to produce an answer.

**Package:** Instructor's Notes (17 pages); software (3 interactive BASIC programs). *Profis I* consists of 749 lines of code; *Profis II*, 490 lines of code; and *Profis III*, 476 lines of code. Level 0 except for Level 1 string variable length.

**Versions:** BASIC, TRS-80

### PUBLIC REACTION TO CIVIL DISOBEDIENCE

**Registry #:** SOC017

**Topics:** public opinion, protest movement, research methods, survey analysis

**Suggested courses:** Social Psychology, Research Methods, Introductory Sociology

**Author:** G. R. Boynton, The University of Iowa, Iowa City, Iowa, 1972.

This data set contains variables from a 1968 national sample survey of the adult U.S. population, conducted by the Survey Research Center at the University of

Michigan. The variables pertain to general public reaction to the protests and demonstrations of the 1960's. Students are led to investigate the relationship of attitudes toward protests and demonstrations.

**Package:** Student Manual/Codebook (42 pages); Notes to Instructor (8 pages); software (data file [48 variables and 716 cases] for use with SPSS or any similar statistical analysis package).

**Version:** data file

SOLAB/MICROTAB (SOC022) IS NO LONGER BEING DISTRIBUTED BY CONDUIT. THE STUDENT MANUAL, LABORATORY MANUAL FOR INTRODUCTORY SOCIOLOGY (SOKOL, ADDISON-WESLEY, 1970) IS NO LONGER AVAILABLE FROM THE PUBLISHER.

### USPOP

**Registry #:** SOC030

**Topics:** population projections, demography

**Suggested course:** Introductory Sociology

**Author:** James Friedland, Huntington Two Computer Project, State University of New York, 1973.

This model, which is oriented toward exploration of United States population projections, can be used to teach key demographic concepts to freshman-level students. Population size and structure can be studied as the student manipulates various predictive factors: fertility, age of mother at birth, sex ratio of the offspring, and age-dependent mortality. Census data from 1970 are the data source.

**Package:** Student Workbook (21 pages); Teacher's Guide (27 pages); Resource Handbook (38 pages); software (interactive BASIC program, 276 lines of code). Level 0.

**Version:** BASIC

## Statistics

### DESCRIPTIVE STATISTICS

**Registry #:** STA114

**Topics:** tabular analysis, graphic analysis, measures of central tendency, measures of dispersion

**Suggested courses:** Descriptive Statistics, Introductory Statistics

**Author:** Harrison D. Weed, Jr., COMPRESS, Inc., Wentworth, New Hampshire, Second edition, 1978. Revised by CONDUIT, October, 1978.

This package provides supplementary materials to standard undergraduate text books for precalculus statistics and probability courses. The package includes a User's Manual, four BASIC computer programs, and three data sets (bell-shaped, skewed, and U-shaped). The Manual discusses several methods of describing and summarizing raw data. The computer programs and example

data sets are provided to give the student practice in applying these methods to actual sets of data. The Manual is self-contained and does not depend upon any other textbook. It is designed to be used as an introduction to descriptive statistics or at the beginning of a precalculus statistics course before introducing probability or the methods of statistical inference. Concepts discussed in the Manual include data types (e.g. nominal), frequency distributions and their graphical representation, measures of location, and measures of dispersion.

The prerequisites for use of the materials are high school algebra, some familiarity with summation notation, and knowledge of how to use a computer terminal. No prior knowledge of statistics or probability is needed, and no computer programming experience is required. There are a few optional programming exercises included for students with some programming background, but programming is not required or taught in the Manual.

**Package:** User's Guide (56 pages); software (four interactive BASIC programs, ranging in size from 272 to 572 lines of code, and 3 data files ranging in size from 63 to 70 numeric data elements). Level 0 except Level 1 sequential input file, file name as input.

**Version:** BASIC

### LABORATORY MANUAL FOR PROBABILITY AND STATISTICAL INFERENCE

**Registry #:** STA036

**Topics:** probability, statistics

**Suggested courses:** Mathematical Statistics and Probability, Introductory Statistics

**Author:** Elliot A. Tanis (Hope College, Michigan), CONDUIT, Revised edition, 1979. Revised by CONDUIT, February, 1979.

This manual, which includes topics, problems, and exercises in mathematical probability and statistics, is designed for a weekly two-hour laboratory to be held in conjunction with a year-long course in mathematical statistics at the junior or senior levels. The materials can be used for student independent study projects, and for classroom demonstrations. Computer use involves student programming in FORTRAN IV.

The package contains over 60 function subprograms and subroutines, and a manual with over 300 exercises and complete solutions for 25 of these exercises. The subprograms include seven distribution functions, the inverses for four different distribution functions, simulation programs for thirteen distributions, and several graphing routines.

**Package:** Student Manual (331 pages); software (62 batch FORTRAN subroutines, ranging in size from 4 to 509 lines of code).

**Version:** FORTRAN

### QUANTITATIVE EXPERIMENTAL ANALYSIS

**Registry #:** STA089

**Topics:** statistical analysis, estimation, experimental design

**Suggested courses:** Statistics for Non-Mathematics Majors



**Authors:** Richard H. Richardson and David H. Stones (University of Texas at Austin), CONDUIT, Iowa City, Iowa, 1978.

This package offers a fresh approach to teaching statistics to nonmathematics majors. Without the traditional requirement of calculus, the materials present the theoretical foundations of statistical analysis, estimation, and experimental design. Students empirically determine the relationships of bias, sample size, assumptions and parameter values to probability functions and tests of significance. Comparisons are made among theoretical and among descriptive mathematical models. In learning these relationships, students learn ways to empirically determine the accuracy, precision, testability and generality of predictions of models. These procedures are discussed in the context of scientific methodology and philosophy.

The specific topics covered in the materials are *Binomial Distributions*; parameters, estimates, moments; *Comparison of Distributions*: discrete and continuous examples; *Central Limit Theorem*: convergence, *z*-distribution; *Power and Significance Level*: group and paired comparisons, *t* and *z* tests, models and hypotheses; *Parametric vs. Non-Parametric Tests*: *t*, *F*, and Mann Whitney tests; *Analysis of Variance*; *Regression Analysis and Model Building*.

**Package:** Student Manual (81 pages); Instructor's Manual (54 pages), software (7 modules in ANS FORTRAN, ranging from 947 to 1,487 lines of code). The software includes separate output units so that the output can be directed to two different locations simultaneously, for example, terminal screen and line printer.

**Version:** FORTRAN

## Multidisciplinary

EXPER SIM (MESS) Model Builder's Kit

**Registry #:** MUL032

**Topic:** modeling

**Author:** Dana Main (University of Michigan) and Robert Stout, CONDUIT, Iowa City, Iowa, 1978.

*Exper Sim* (experimental simulation) is a computer-based system that helps instructors create and use simulated models for instruction in a number of disciplines. In disciplines based on empirical research, one of the most effective ways to help students learn the art of asking the right question and the strategy of developing the best answer is to have them "play at" being researchers. However, this approach is very expensive. Many of the difficulties of independent research can be minimized using simulated problems for the students' research.

*Exper Sim* is a set of computer programs and associated instructional techniques using simulation to teach research methodology in a variety of disciplines. While the approach was originally introduced in psychology, it has spread to applications in many other disciplines. The computer programs simulate a limited set of phenomena. The student, by interacting with the computer programs,

learns about the particular phenomenon, and develops skills in asking research questions.

The student specifies the particular research by indicating the kinds of data and the conditions of collecting the data. Thus, each student in a class can conduct a separate, unique experiment. Since the computer generates the data, specialized research equipment is not needed. Computer generation of the data also eliminates the time-consuming data collection step of real experiments, thus permitting students to design and analyze complex studies in a short period of time. In response to each design, the computer program returns sets of realistic data to represent pointer readings, counts, scores on tests, and other types of measurement. Students then analyze the data, draw conclusions, and design new experiments. As they compare the conclusions from several experiments, they learn which types of research design apply to a given inquiry.

This Model Builder's Kit is intended for instructors who wish to create their own *Exper Sim* model. If you are interested in using the models currently available from CONDUIT, see the *Psychology* section.

**Package:** Readings on EXPR SIM (40 pages); Model Builder's Manual (85 pages); Programmer's Manual (109 pages); software (interactive or batch FORTRAN) includes MESS programmer version driver (2,820 source card images), MESS student version driver (911 source-card images), subroutines required by both drivers (2,077 source-card images) [about one-half of the source images in MESS are comment statements], 24 model building subroutines ranging in size from 30 to 230 source images, a random number table for testing, and two sample models (subroutine and data files).

**Version:** FORTRAN

USER FRONTEND

**Registry #:** MUL220

**Topic:** student/computer interface

**Author:** Stephen Hirst, CONDUIT, Iowa City, Iowa, 1978.

The *User Frontend* Package provides a unified processing mechanism for student input that reduces the need for redundant error checking code, and provides uniform treatment of all user input. The routines are modular, and operate independently from the organization of the main routine, thus allow-

ing programmers to select only the subset required in the particular application. By avoiding a well-defined set of variable names and range of line numbers, any BASIC language program application can be designed to use the subroutines.

All the subroutines are designed to be as tolerant as possible of "errors" in user input. The user's input is uniformly treated as a character string which is always prescanned to assure that no error condition will arise prior to any manipulation of the string.

The *General Purpose Routines* (three subroutines) provide the ability to: convert mixed case input to all upper case; to remove redundant blanks; and to recognize a predefined set of special commands. This group also includes a routine which handles the responses to yes or no questions.

The subroutine *Value*, from the *Numeric Answer Processing Group*, converts character strings representing numeric quantities into floating point values. This subroutine can be modified to fit any particular machine environment by altering the constants which specify the number of digits of precision and the maximum exponent for the given system. *Value* recognizes and takes appropriate action for syntax errors, overflow and underflow conditions, and loss of digits due to machine precision. This action is taken without generating any system error messages.

The final group of subroutines is the *Pattern Matching Routines*. This group includes the subroutine *Match* which compares the user's input with a pattern supplied by the calling program. This pattern may contain alphanumeric characters which are to be matched exactly, and may also contain one or more special characters which match any alphanumeric character. The "single-don't care-character" is the symbol #, and matches any single character. The "multiple-don't care-character" is the &, and matches any sequence of zero or more characters. The representations of these two special symbols can be altered.

**Package:** User's Guide (90 pages); (10 BASIC programs ranging in size from 29 to 610 lines of code). *Level 0*.

**Version:** BASIC

## Are You Using the User Frontend?

Please note that our stipulation prohibiting redistribution applies to the *User Frontend* the same as all other packages. If you develop materials incorporating the routines from this package and intend to distribute the package, you must make special provisions for these routines. Two options are available:

- (1) You may distribute your package without the *User Frontend* routines, and refer recipients of your package to CONDUIT to purchase the routines.
- (2) You may submit your materials to CONDUIT to review and possibly distribute. In this instance, incorporation of the routines would pose no problem. If you are interested in submitting your materials for review, please contact CONDUIT for further information.



## CONDUIT Computer-Based Curriculum Packages Price List

The prices for each package, additional micro media, and for any additional texts are listed below. Each package consists of software (in machine readable form, or listed in the manual), one copy of each relevant manual, and instructions or notes for installing the program on your computer.

**Note:** Please see the Catalog section for implementation and machine restrictions for each package. Orders for 10 or more copies of any text (student or instructor) qualify for a 20% discount.

| Registry<br>Number | Title                                                      | Package<br>Price | Additional<br>Micro<br>Media * | Additional<br>Texts                   | Versions                     |
|--------------------|------------------------------------------------------------|------------------|--------------------------------|---------------------------------------|------------------------------|
| <b>Biology</b>     |                                                            |                  |                                |                                       |                              |
| BIO082             | <i>EVOLUT</i><br>(includes 6 student manuals)              | \$30.00          | \$10(C), \$10(D)               | Student, \$1.50<br>Instructor, \$1.50 | BASIC, PET,<br>Apple, TRS 80 |
| BIO083             | <i>Ecological Modeling</i><br>(includes 3 student manuals) | \$60.00          | \$10(C), \$10(D)               | Student, \$5                          | BASIC, PET,<br>Apple, TRS 80 |
| BIO087             | <i>ECOEXX I</i>                                            | \$60.00          |                                | Student, \$4                          | FORTRAN                      |
| BIO118             | <i>COEXIST</i><br>(includes 6 student manuals)             | \$30.00          | \$10(C), \$10(D)               | Student, \$1.50<br>Instructor, \$1.50 | BASIC, PET,<br>Apple, TRS 80 |
| BIO122             | <i>LINKOVER</i><br>(includes 6 student manuals)            | \$30.00          | \$10(C), \$10(D)               | Student, \$1.50<br>Instructor, \$1.50 | BASIC, PET,<br>Apple, TRS 80 |
| BIO181             | <i>ENZKIN</i><br>(includes 6 student manuals)              | \$30.00          | \$10(C), \$10(D)               | Student, \$1.50<br>Instructor, \$1.50 | BASIC, PET,<br>Apple, TRS 80 |
| BIO182             | <i>COMPETE</i><br>(includes 6 student manuals)             | \$30.00          | \$10(C), \$10(D)               | Student, \$1.50<br>Instructor, \$1.50 | BASIC, PET,<br>Apple, TRS 80 |
| BIO205             | <i>Computers in the Biology Curriculum</i>                 | \$60.00          |                                | Instructor, \$30.00                   | BASIC                        |
| BIO248             | <i>Tribbles</i><br>(includes 5 student manuals)            | \$35.00          |                                | Student, \$2                          | BASIC                        |
| BIO293             | <i>ENZYME-SEQUEN</i><br>(includes 5 student manuals)       | \$35.00          |                                | Student, \$1                          | BASIC                        |
| BIO296             | <i>ECOEXX II</i>                                           | \$70.00          |                                | Student, \$4                          | FORTRAN                      |

\* C = cassette; D = mini-diskette (5 1/4")

Prices subject to change at the discretion of CONDUIT.

| Registry Number  | Title                                                           | Package Price | Additional Micro Media * | Additional Texts                                       | Versions                     |
|------------------|-----------------------------------------------------------------|---------------|--------------------------|--------------------------------------------------------|------------------------------|
| <b>Chemistry</b> |                                                                 |               |                          |                                                        |                              |
| CHM011           | IDGAME                                                          | \$65.00       |                          | Student, \$2<br>Instructor, \$3                        | FORTRAN                      |
| CHM081           | FRSTLW                                                          | \$45.00       |                          | Instructor (BASIC), \$2<br>User's Guide (FORTRAN), \$2 | BASIC,<br>FORTRAN            |
| CHM088           | KSIMS<br>(includes 5 student manuals)                           | \$75.00       |                          | Student, \$1.50<br>Instructor, \$3.50                  | FORTRAN                      |
| CHM102           | TITRATION                                                       | \$85.00       |                          | User's Guide, \$3                                      | BASIC,<br>FORTRAN            |
| CHM119           | Neutron Activation Analysis                                     | \$40.00       |                          | Student, \$2<br>Instructor, \$3                        | FORTRAN                      |
| CHM138           | Quantum Chemistry                                               | \$60.00       |                          | Student, \$2.50                                        | BASIC,<br>FORTRAN            |
| CHM160           | RKINET<br>(includes 6 student manuals)                          | \$30.00       | \$10(C), \$10(D)         | Student, \$1.50<br>Instructor, \$1.50                  | BASIC, PET,<br>Apple, TRS-80 |
| CHM199           | HABER<br>(includes 6 student manuals)                           | \$30.00       | \$10(C), \$10(D)         | Student, \$1.50<br>Instructor, \$1.50                  | BASIC, PET,<br>Apple, TRS-80 |
| CHM226           | NMR                                                             | \$60.00       |                          | Instructor, \$4                                        | FORTRAN                      |
| CHM252           | X-RAY                                                           | \$60.00       |                          | Instructor, \$4                                        | FORTRAN                      |
| CHM254           | Chemistry Laboratory Simulations                                | \$40.00       | \$10(C), \$10(D)         | Instructor, \$2                                        | PET                          |
| <b>Economics</b> |                                                                 |               |                          |                                                        |                              |
| ECN043           | Computer Simulation Policy Games in Macroeconomics              | \$60.00       |                          | Student, \$2<br>Instructor, \$7                        | BASIC                        |
| ECN239           | MODSIM<br>(includes 5 student manuals)                          | \$125.00      |                          | Student, \$5<br>Instructor, \$5                        | FORTRAN                      |
| <b>Education</b> |                                                                 |               |                          |                                                        |                              |
| EDU034           | GHETTO                                                          | \$55.00       |                          | Instructor, \$2                                        | BASIC                        |
| EDU154           | Critical Incidents in Education<br>(includes 5 student manuals) | \$70.00       |                          | Student, \$2<br>Instructor, \$2                        | BASIC                        |
| <b>Geography</b> |                                                                 |               |                          |                                                        |                              |
| GEO091           | Optimal Location of Facilities                                  | \$75.00       |                          | Student, \$7.95<br>Technical Doc., \$7.50              | FORTRAN                      |

Prices subject to change at the discretion of CONDUIT.

\* C = cassette; D = mini-diskette (5 1/2")



| Registry Number           | Title                                                         | Package Price | Additional Micro Media * | Additional Texts                                              | Versions       |
|---------------------------|---------------------------------------------------------------|---------------|--------------------------|---------------------------------------------------------------|----------------|
| <b>Humanities</b>         |                                                               |               |                          |                                                               |                |
| HUM143                    | DIALOGUE                                                      | \$100.00      |                          | Instructor, \$3                                               | BASIC          |
| HUM203                    | SPANCOM                                                       | \$150.00      |                          | Student, \$4<br>Instructor, \$2                               | BASIC          |
| <b>Management Science</b> |                                                               |               |                          |                                                               |                |
| MSC007                    | Computer Models in Operations Management                      | \$75.00       |                          | Student, \$14 <sup>†</sup>                                    | FORTRAN        |
| MSC008                    | Computer Augmented Cases in Operations & Logistics Management | \$70.00       |                          | Student, \$9 <sup>†</sup>                                     | FORTRAN        |
| MSC035                    | FINANSIM                                                      | \$70.00       |                          | Student, \$11 <sup>†</sup>                                    | FORTRAN        |
| MSC039                    | SIMQUEUE                                                      | \$35.00       |                          | Student, \$2                                                  | FORTRAN        |
| MSC042                    | TEMPOMATIC IV                                                 | \$70.00       |                          | Student, \$11 <sup>†</sup><br>Instructor, \$3 <sup>†</sup>    | FORTRAN        |
| MSC048                    | Marketing in Action                                           | \$70.00       |                          | Student, \$6 <sup>†</sup>                                     | FORTRAN        |
| MSC054                    | The Executive Game                                            | \$70.00       |                          | Student, \$7.50 <sup>†</sup>                                  | FORTRAN        |
| MSC055                    | Business Management Laboratory                                | \$70.00       |                          | Student, \$9 <sup>†</sup><br>Administrator, \$11 <sup>†</sup> | FORTRAN        |
| MSC084                    | Computer Models in Operations Research                        | \$80.00       |                          | Student, \$13 <sup>†</sup><br>Instructor, \$3.50 <sup>†</sup> | FORTRAN        |
| MSC110                    | Business Decision Simulation                                  | \$55.00       |                          | Student, \$8.50 <sup>†</sup>                                  | BASIC          |
| <b>Mathematics</b>        |                                                               |               |                          |                                                               |                |
| MTH002                    | A Computer-Oriented Course in Linear Algebra                  | \$45.00       |                          | Student, \$5                                                  | FORTRAN        |
| MTH047                    | BERTIE                                                        | \$95.00       |                          | User's Manual, \$4.95                                         | BASIC          |
| MTH104                    | Computer Programming Supplement for Linear Algebra            | \$60.00       |                          | Student, \$3.50                                               | BASIC          |
| MTH105                    | Interface                                                     | \$55.00       |                          | Student, \$11 <sup>†</sup><br>Instructor, \$2.50              | BASIC, FORTRAN |
| MTH150                    | Computer Laboratory in Calculus and Linear Algebra            | \$60.00       |                          | Student, \$7.50                                               | BASIC          |
| MTH152                    | SURFACE                                                       | \$30.00       |                          | Student, \$4.50                                               | BASIC, FORTRAN |

\* C = cassette; D = mini-diskette (5 1/2")

† Orders for multiple copies of these texts should be sent to the publisher to obtain college bookstore discounts.

Prices subject to change at the discretion of CONDUIT.

| Registry Number | Title                                              | Package Price | Additional Micro Media * | Additional Texts                | Versions |
|-----------------|----------------------------------------------------|---------------|--------------------------|---------------------------------|----------|
| MTH229          | <i>Algebra Drill and Practice</i>                  | \$100.00      |                          | Instructor, \$4                 | BASIC    |
| MTH243          | <i>MATHPROGRAM</i><br>(includes 5 student manuals) | \$60.00       |                          | Student, \$4<br>Instructor, \$4 | BASIC    |

## Physics

|        |                                                |         |                  |                                       |                              |
|--------|------------------------------------------------|---------|------------------|---------------------------------------|------------------------------|
| PHY003 | <i>Using Computers in Physics</i>              | \$60.00 |                  | Student, \$11                         | BASIC                        |
| PHY006 | <i>Quantum Mechanics</i>                       | \$10.00 |                  | Student, \$9                          | BASIC                        |
| PHY053 | <i>ICBM I</i>                                  | \$7.00  |                  | Student, \$3.50<br>Instructor, \$2.50 | BASIC                        |
| PHY057 | <i>Mechanics</i>                               | \$5.00  |                  | Student, \$2<br>Instructor, \$2       | BASIC                        |
| PHY092 | <i>ICBM II</i>                                 | \$5.00  |                  | Student, \$4                          | BASIC                        |
| PHY129 | <i>SCATTER</i><br>(includes 6 student manuals) | \$30.00 | \$10(C), \$10(D) | Student, \$1.50<br>Instructor, \$1.50 | BASIC, PET,<br>Apple, TRS-80 |
| PHY130 | <i>NEWTON</i><br>(includes 6 student manuals)  | \$30.00 | \$10(C), \$10(D) | Student, \$1.50<br>Instructor, \$1.50 | BASIC, PET,<br>Apple, TRS-80 |
| PHY183 | <i>INTERP</i><br>(includes 6 student manuals)  | \$30.00 | \$10(C), \$10(D) | Student, \$1.50<br>Instructor, \$1.50 | BASIC, PET,<br>Apple, TRS-80 |

## Political Science

|        |                                                       |          |  |                                          |          |
|--------|-------------------------------------------------------|----------|--|------------------------------------------|----------|
| POL018 | <i>Voting Behavior in the U.S., 1952-1976</i>         | \$60.00  |  | Codebook, \$2.50                         | data set |
| POL020 | <i>Citizens and the Political System</i>              | \$55.00  |  | Codebook, \$2.50                         | data set |
| POL021 | <i>Voting Behavior in Western Europe</i>              | \$55.00  |  | Codebook, \$2.50                         | data set |
| POL050 | <i>INS2</i>                                           | \$110.00 |  | Participant's, \$2.50<br>Instructor, \$2 | BASIC    |
| POL125 | <i>Supreme Court in American Politics</i>             | \$35.00  |  | Student, \$5                             | data set |
| POL126 | <i>U.S. Energy, Environment and Economic Problems</i> | \$35.00  |  | Student, \$5                             | FORTRAN  |
| POL128 | <i>Voting Behavior: The 1972 Election</i>             | \$35.00  |  | Student, \$5                             | data set |
| POL131 | <i>Representation in the U.S. Congress: 1973</i>      | \$35.00  |  | Student, \$5                             | data set |
| POL132 | <i>Political Participation</i>                        | \$35.00  |  | Student, \$5                             | data set |

Prices subject to change at the discretion of CONDUIT.

\* C = cassette; D = mini-diskette (5 $\frac{1}{2}$ " )



| Registry Number          | Title                                                                         | Package Price | Additional Micro Media * | Additional Texts                                                         | Versions             |
|--------------------------|-------------------------------------------------------------------------------|---------------|--------------------------|--------------------------------------------------------------------------|----------------------|
| POL133                   | <i>Political Socialization</i>                                                | \$35.00       |                          | Student, \$5                                                             | data set             |
| <b>Psychology</b>        |                                                                               |               |                          |                                                                          |                      |
| PSY051                   | <i>Cognitive Psychology</i>                                                   | \$50.00       |                          | Student, \$6.95<br>Instructor, \$2                                       | BASIC                |
| PSY192                   | <i>IMPRINT</i><br>(includes 5 student manuals)                                | \$35.00       |                          | Student, \$2.50<br>Instructor, \$2.50                                    | FORTTRAN             |
| PSY194                   | <i>SCHIZ</i><br>(includes 5 student manuals)                                  | \$35.00       |                          | Student, \$2.50<br>Instructor, \$2.50                                    | FORTTRAN             |
| PSY224                   | <i>Laboratory in Cognition and Perception</i><br>(includes 5 student manuals) | \$100.00      | \$10(D)                  | Student, \$5<br>Instructor, \$8                                          | BASIC, Apple, TRS-80 |
| <b>Sociology</b>         |                                                                               |               |                          |                                                                          |                      |
| SOC017                   | <i>Public Reaction to Civil Disobedience</i>                                  | \$55.00       |                          | Codebook, \$2.50                                                         | data set             |
| SOC019                   | <i>Changing Attitudes toward Integration</i>                                  | \$55.00       |                          | Codebook, \$2.50                                                         | data set             |
| SOC030                   | <i>USPOP</i>                                                                  | \$20.00       |                          | Student, \$1<br>Teacher, \$1.50<br>Resource, \$2                         | BASIC                |
| SOC097                   | <i>Change Agent</i>                                                           | \$35.00       | \$10(D)                  | Student, \$2<br>Instructor, \$3                                          | BASIC, TRS 80        |
| SOC156                   | <i>PROFIS I, II, III</i>                                                      | \$40.00       | \$10(D)                  | Instructor, \$3                                                          | BASIC, TRS 80        |
| SOC163                   | <i>Cumulative General Social Survey Data File</i>                             | \$115.00      |                          | Codebook, \$6                                                            | data set             |
| SOC164                   | <i>DEMO GRAPHICS</i>                                                          | \$65.00       |                          | User's Manual, \$7.50                                                    | BASIC                |
| <b>Statistics</b>        |                                                                               |               |                          |                                                                          |                      |
| STA036                   | <i>Laboratory Manual for Probability &amp; Statistical Inference</i>          | \$90.00       |                          | Student, \$7.50                                                          | FORTTRAN             |
| STA089                   | <i>Quantitative Experimental Analysis</i>                                     | \$100.00      |                          | Student, \$4<br>Instructor, \$4                                          | FORTTRAN             |
| STA114                   | <i>Descriptive Statistics</i>                                                 | \$60.00       |                          | Student, \$5.95                                                          | BASIC                |
| <b>Multidisciplinary</b> |                                                                               |               |                          |                                                                          |                      |
| MUL032                   | <i>EXPER SIM (MESS)</i><br>Model Builder's Kit                                | \$95.00       |                          | Readings, \$5<br>Model Builder's Guide, \$10<br>Programmer's Guide, \$10 | FORTTRAN             |
| MUL220                   | <i>User Frontend</i>                                                          | \$40.00       |                          | User's Manual, \$10                                                      | BASIC                |

\* C = cassette; D = mini-diskette (5 1/2")

Prices subject to change at the discretion of CONDUIT.

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## Transfer Media Changes and Policy

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Recent changes in the computing equipment available to CONDUIT for copying our materials for transfer are reflected in the options for transfer media listed on our revised order form (facing page). To meet the changing computing scene, new media options have also been added. These new options and changes are discussed below in order to clarify our new order form and help you in ordering packages from CONDUIT.

### Media Changes

In response to frequent requests from our customers, CONDUIT has added a new distribution media—soft-sectored, 8-inch, single-density, single-side diskettes. **Diskettes are available from CONDUIT in either the IBM Basic Data Exchange format (EBCDIC code) or the DEC RT-11 format (ASCII code).** Other formats will be considered in the future based on customer demand.

Customers can also now request nine-track magnetic tapes recorded at 800, 1600, or 6250 bpi (bits-per-inch) density. Nine-track tapes (EBCDIC or ASCII) are always odd parity (eight-bit code plus one-bit magnetic tape parity for a total of nine bits or nine tracks). However, for the ASCII code, the ASCII parity bit (the eighth bit) must be specified. For this eight-bit code, a parity bit (either even, odd, or no parity) is added to the seven-bit ASCII code. **Incorrect ASCII parity setting can cause a magnetic tape to be unreadable on many computers.** Please check with a local expert if you are unsure of the ASCII parity.

Blocked magnetic tapes are also now available from CONDUIT. When ordering a blocked tape, please specify the maximum block size in characters for your computer. **If you are unsure if your computer can read blocked tapes, please request an unblocked tape.**

**Seven-track magnetic tapes are no longer available from CONDUIT.** We can, however, produce 80-column punched cards in the EBCDIC (029) or BCD (026) formats.

On our order form, we have more clearly defined the common options for papertape creation. Trailing blanks will be trimmed from program source code records and followed by end-of-line characters specified by the customer. Typically, systems require only a CR (Carriage Return) followed by a LF (Line Feed) as end-of-line characters. Some systems also require a DC3 (Device-Control-3 or control-S) to terminate lines. The customer can also define end-of-file characters. Systems requiring an end-of-file character typically need a SUB (SUBstitute or control-Z) or DC3 character. All papertapes are generated in seven-bit ASCII code with even parity being the most common specification for the eighth papertape bit.

### Policy

The technical descriptions included with the package descriptions in our catalog are critical in determining if a package can be implemented on a particular computer system. Please read these technical notes carefully before ordering any package. If you have questions about the transferability of any package to your computer, please call us. **Versions of our packages for specific main-frame or mini-computers are not available.** Being able to read a distribution medium created by CONDUIT does not imply that the software on the medium is written in your dialect of FORTRAN or BASIC. Due to the many nonstandard dialects of BASIC available today, customers ordering packages written in BASIC should pay particular attention to the package descriptions. Some of our packages written in BASIC require little, if any, editing on most systems, but a few (as noted in the package descriptions) use features that may have to be modified for your computer.

**CONDUIT will provide technical support for implementation of the materials we distribute for six months after shipment. To honor any requests concerning damaged, missing, or unreadable materials (distribution medium or printed materials), CONDUIT must be notified within sixty days after shipment.** Beyond sixty days, the customer will be charged for the replacement. (Due to increased shipment time, this time period will be extended accordingly for customers in foreign countries.) Also, **a customer will be charged a reprocessing fee for replacement of a distribution media incorrectly ordered by the customer.**

Our order form is complex, but the information is necessary in order for us to send you the correct machine-readable media. **If you are not sure how to complete the technical information requested on the form, please consult someone in your computer center, or call us (telephone: 319-353-5789) for assistance.** Correctly completing our order form will quicken processing of your order and could save you from having to reorder at additional expense.





# CONDUIT Order Form

The information on both sides of this form must be supplied in order to fill your request. You can help us assure that our packages are usable on your system by providing the information yourself, or if you are unfamiliar with the technical specifications of your computer, by enlisting the help of a local computing expert in completing this form. Please contact us (telephone 319-353-5789) for any additional explanation needed in completing this form, or for assistance in judging the transferability of any package to your computer.

Language conventions followed for FORTRAN programs are set forth by the American National Standards Institute (ANSI), 1966. Due to the many dialects of BASIC available today, CONDUIT has defined BASIC standards to ease transfer. A complete description of the BASIC language standards adopted by CONDUIT can be found in the *CONDUIT BASIC Guide*, J. Frederick, (ed.), 1979. This document may be ordered from CONDUIT.

## Computer (CPU) for which Standard BASIC or FORTRAN Program is Being Obtained

Manufacturer/Model: \_\_\_\_\_

Operating System/Version: \_\_\_\_\_

If package is to be sent in BASIC, state version used on your system: \_\_\_\_\_

## Microcomputer for which Micro Version is Being Obtained

Manufacturer/Model: \_\_\_\_\_

Operating System/Version: \_\_\_\_\_

If package is to be sent in BASIC, state version used on your system: \_\_\_\_\_

## TECHNICAL CONTACT

Name: \_\_\_\_\_  
(please print)

Position: \_\_\_\_\_

Telephone: \_\_\_\_\_  
area code      number

## Medium for Transferring Microcomputer Versions

- ☐ Cassette for PET
- ☐ Disk II Floppy Disk for Apple II
- ☐ Floppy Disk for PET
- ☐ Mini Disk for TRS 80

(Cassette media not available for TRS-80 or Apple II.)

## Medium for Transferring Standard BASIC and FORTRAN Versions

Software for standard packages is normally supplied by CONDUIT on one of the following media. The package price includes the cost of the distribution media. A listing of the software is always included with each package.

### ☐ Nine Track Magnetic Tape (no labels, odd parity, fixed-length records)

- density    ☐ 800 bpi  
            ☐ 1600 bpi  
            ☐ 6250 bpi
- code        ☐ ASCII  
            ASCII parity bit    ☐ even  
                                  ☐ odd  
                                  ☐ no (always zero)
- ☐ EBCDIC
- blocking    ☐ unblocked (one record per physical tape block)  
            ☐ blocked, maximum block size  
                                  (in characters) \_\_\_\_\_

### ☐ Punched Cards (80 column cards)

- code        ☐ EBCDIC ("029")  
            ☐ BCD ("026")

### ☐ Flexible Disk (eight-inch, soft-sectored, single-density, single-side)

- format      ☐ IBM Basic Data Exchange (EBCDIC code)  
            ☐ ODEC RT-11 (ASCII code)

### ☐ Paper Tape (ASCII code, trailing blanks trimmed from records)

- ASCII parity ☐ even  
                  ☐ odd  
                  ☐ no (always zero)
- end-of-line ☐ OCR, LF  
characters    ☐ OCR, LF, DC3 (DC3 is control-S)  
            ☐ Other (please specify) \_\_\_\_\_
- end-of-file    ☐ none  
character      ☐ OSUB (also called control-Z)  
                  ☐ ODC3 (also called control-S)  
                  ☐ Other (please specify) \_\_\_\_\_

### ☐ Listing only (no machine-readable medium)

### ☐ Other

To save confusion and time, it is best to call us before requesting a distribution media or format not mentioned above for transferring standard BASIC or FORTRAN versions of packages (telephone 319-353-5789).

# CONDUIT Order Form

The information on both sides of this form must be supplied to CONDUIT before your order can be processed. Please provide all information requested, and attach to your purchase order.

| Registry # | Package Title                                                             | Version * | Please check one: Is item a |                |                |              |                   | Qty. | Unit Price   | Total |
|------------|---------------------------------------------------------------------------|-----------|-----------------------------|----------------|----------------|--------------|-------------------|------|--------------|-------|
|            |                                                                           |           | Package                     | Student Manual | Teacher Manual | Other Manual | Add'l Micro Media |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            | Author's Guide                                                            |           |                             |                |                |              |                   |      | 10.00        |       |
|            | The CONDUIT BASIC Guide                                                   |           |                             |                |                |              |                   |      | 10.00        |       |
|            | 1979 CONDUIT State of the Art Reports of Instructional Computing          |           |                             |                |                |              |                   |      | 15.00        |       |
|            | The Best of Pipeline                                                      |           |                             |                |                |              |                   |      | 2.00         |       |
|            | Subscription to Pipeline (\$15 within the continental U.S., \$25 outside) |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      |              |       |
|            |                                                                           |           |                             |                |                |              |                   |      | <b>TOTAL</b> |       |

\*If more than one version (e.g., BASIC, Apple II) is available, please specify version.

CONDUIT orders are usually shipped via United Parcel Service. Shipping and handling charges (averaging \$2 per unit) will be added to the above TOTAL. **To avoid shipping and handling charges, please prepay.** Orders mailed outside the continental U.S. will be charged actual shipping and handling, with **no** exceptions. These orders will be mailed surface U.S. mail unless otherwise specified (average two month delivery).

Please make checks payable to CONDUIT.  
☐ Check enclosed. ☐ Please bill Purchasing.

Please return completed form to  
**CONDUIT, P.O. Box 388, Iowa City, Iowa 52244.**

## Customer Agreement

Customer agrees not to redistribute CONDUIT programs or materials. Program sets are distributed for use on a single computer (CPU): customer agrees that the software will be copied only for use on the CPU specified on reverse side of form. Customer agrees to report any missing or damaged materials to CONDUIT within 60 days of shipment from CONDUIT, to avoid any reprocessing charges. There will be a reprocessing charge for incorrectly ordered media. Customer also agrees to forward to CONDUIT any nontrivial changes made to, and errors detected in, the programs or materials, and to supply CONDUIT upon request with information on the success of the implementation and use of these materials. CONDUIT assures that the programs will operate as described, and will provide programming support for implementation of materials for up to six months from date of shipment from CONDUIT.

### SOLD TO:

|             |          |     |
|-------------|----------|-----|
| Customer    |          |     |
| Department  | Building |     |
| Institution |          |     |
| City        | State    | ZIP |
| Telephone   |          |     |

X

Customer Signature

For office use:

|               |  |                |  |
|---------------|--|----------------|--|
| P.O. #        |  | Item Total     |  |
| Date received |  | S & H          |  |
| Computer      |  | Spec. Handling |  |
| Tape Spec.    |  | Total          |  |
| Invoice to:   |  | Prepaid Amt.   |  |
| Ship to:      |  | Refund         |  |
|               |  | Due            |  |
| Invoice #     |  |                |  |

see reverse side